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OF SURGICAL PATIENTS

VOL. I

THE AFTER-TREATMENT
OF
SURGICAL PATIENTS

BY

WILLARD BARTLETT, A.M., M.D., F.A.C.S.

AND

COLLABORATORS

VOL. I

WITH TWO HUNDRED TWENTY-TWO ORIGINAL ILLUSTRATIONS AND ONE COLOR PLATE

ST. LOUIS
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TO
THE MEMORY OF MY FATHER
AURELIUS TWOMBLEY BARTLETT, M.D.

"WHO EVER CHOSE THE HARDER WAY,
WHICH IS THE PATH
THAT CAN BE TRODDEN ONLY
BY THE FOOT OF A MAN"
(Farnol)

47350

PREFACE

Fortunately, every mammalian entity is a machine highly endowed with possibilities of automatic adjustment and repair. Among the lower animals, those that are wild must depend upon themselves during the period of repair that follows an injury which is not immediately fatal. Our domestic animals, more fortunately situated, do experience a certain amount of external aid in similar times of distress, while man is practically never without sympathetic, and in many instances, scientifically directed care, whenever he experiences any deviation from the normal physiologic tenor of his existence.

Always granting a correct diagnosis, promptly established operative indications, and well appraised pathologic conditions amenable to surgical treatment, it is true, in the majority of instances, that the need of after-treatment is in inverse proportion to the quality of work done on the operating table. Be this as it may, some of our patients do perfectly well if let alone, while many of them are made much more comfortable by properly directed after-care, and a few are certainly lost for the lack of it.

In this volume, in most instances, the consideration of surgical technic has been omitted; however, instances will arise in which mention of certain operative details must be made, in order that the therapeutic suggestions may be completely understood. Surgical after-treatment has been considered as beginning when the last suture is tied, and lasting until the patient is restored to normal health. My follow-up system, to which attention has been called elsewhere in this work, contemplates a correspondence with every patient for at least one year following the operation, but one can imagine a much more lengthy course of after-treatment in certain individuals, e. g., those who are compelled to live within definite limits after such operations as are performed for the cure of pyloric ulcer.

Such a work naturally divides itself into two parts: one which has to do with general subjects, and the other, with the measures of after-treatment as they are applied following operations upon the various organs. One must place some practical limit upon the scope of such a work, hence, no consideration has been given to the postoperative consequences and the treatment of some extremely rare procedures, especially those handled by the sharply restricted specialists. However, it was thought well to give detailed attention to many of the procedures from special fields, which may at times confront the worker in general medicine or surgery.

It is hoped that this book will make an appeal to those who, like myself, have at times desired this subject treated more in detail than is possible in the excellent works on general surgery at our command.

If originality seems to have been claimed for any of the methods herein advocated, or even for the form in which they are presented, it is done with full knowledge that "there is nothing new under the sun" in the field of medicine, and in the hope that faulty information may not often prevent giving credit for priority when it is due.

The procedures which my collaborators and I recommend have practically all proved their worth in an extensive personal experience, still, we all have, as will be noted, drawn freely and impartially from the literature, striving always to be scrupulously fair in acknowledging our indebtedness to others. It is no less a pleasure than a duty to emphasize in a general way this obligation on our part if anywhere we may have seemed remiss.

Dr. O. F. McKittrick's chapters speak for themselves; still it is with the utmost satisfaction that I here accord him unstinted praise and appreciation for his untiring efforts while he, as my house surgeon, collected many of the clinical data on which this work is based.

Not only am I fortunate, but the reader as well, that eleven of the chapters have been most graciously contributed by men who are especially qualified to handle the subjects in question. Their names appear under the titles of their respective chapters. In addition to these writers, I desire to thank Doctors William J. Mayo, Charles H. Mayo, George W. Crile, Stuart McGuire, and Joseph Bloodgood for inspiration and assistance which has been invaluable.

Dr. S. F. Wennerman kindly corrected the manuscript of many chapters and Dr. F. K. Hensel proved a painstaking, faithful coworker in helping place the numerous illustrations.

WILLARD BARTLETT.

St. Louis, Mo.

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THE AFTER-TREATMENT OF SURGICAL PATIENTS

VOL. I.

CHAPTER I

THE IDEAL POSTOPERATIVE ROOM

By O. F. McKittrick, St. Louis, Mo.

One of the important considerations confronting the prospective operative patient is the choice of a room in which to pass his convalescence. This is probably a matter of very little import to the ordinary individual during the first few days of his stay, but soon the newness of his surroundings begins to wear off, he is no longer engrossed by his postoperative discomfort, and he begins an actual appraisement of what is in sight and earshot.

The ideal room should be situated above the first floor of the hospital or nursing home, and so arranged as to receive the benefit of a southern exposure for sunshine in winter and breeze in summer. The *ideal* building is one located upon high ground with long green lawns sloping to the street several hundred feet away, and the windows placed so low that the patient, even though in bed, can look out upon the outside world.

The noises of the street should not reach the patient, neither should many of those arising within the building. The same may be said of the odors from the serving room or kitchen. The room (Fig. 1) should be so far as practical removed from the service portion of the house. If possible, a private bathroom may be connected with the sick room (an anteroom alone intervening) on the one side, and a sun parlor or porch is to be desired on the other. It is well to have one side of the room adjoining a main hall where the patient can be taken in bad weather for frequent rides and change of scene as he improves. Heavy doors made of solid wood are desirable, since these tend to eliminate unnecessary noise when they are closed. All the openings should be spacious, and a transom over each door and window will be found very convenient. To prevent sudden slamming of doors, a knit cuff may be fastened over the latch (Fig. 2).

The size of the room should be at least 13x16 feet, but larger dimensions are not undesirable. The height depends upon the width and breadth, ranging from 12 to 15 feet. The patient requires at least 1200 cubic feet of air, which calls for 80 square feet of a room, with a 16-foot ceiling; therefore a room of the minimum dimensions will more than accommodate the nurse also.

The walls and ceiling both should be glazed so as to permit of frequent washing and painted in some solid color. Probably light green is the best since this is cheerful and at the same time most restful to the eye.

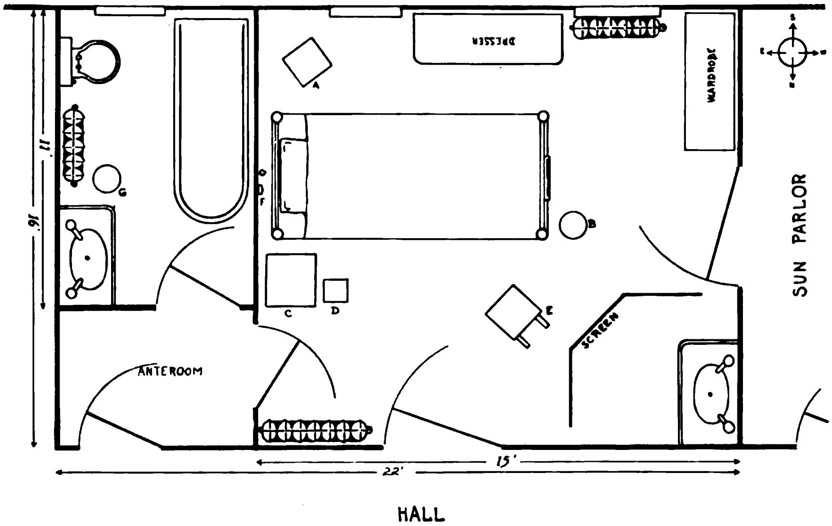


Fig. 1.—Ground plan of postoperative room, anteroom, and sun parlor.

A, Small bedside table for patient; *B*, foot stool; *C*, small stand for nurse; *D*, straight-back chair for nurse; *E*, rocking chair; *F*, push button for signaling nurse (note the reading light at the head of the bed next to signal button); *G*, short straight-back chair in bath room.

Polished oak or pine which is easily kept clean makes the best floor. The heating should be uniform and of a kind which is least disturbing to the patient. No doubt the hot water system gives as much satisfaction as any.

The general illumination of the room is best secured by an inverted reflector hung fairly low from the middle of the ceiling, and controlled by a switch at the side of the door. A socket should be located near the floor for a portable electric reading light at the head of the bed, and another socket placed near the dresser, which can be utilized for a fan, heater, examination light or other convenience. The reading light must be so placed as to be easily manipulated by the patient. In addition to this light, a signal cord is constantly kept within easy reach at the head of the bed. Every modern hospital room should have telephone connection if desired.

The furnishings should be as homelike as is compatible with modern hospital ideas. White enameled iron bedstead (Figs. 3 and 4) and mahogany furniture are very attractive. Such furniture requires frequent cleaning in order to look presentable, and this is an added factor of safety to the patient. A small rug here and there, which can be easily taken out and cleaned daily, is all that is necessary for a floor covering. White scrim sash curtains serve to detract from the bareness which is sometimes apparent in the ordinary hospital room. A bed which is 42 inches wide and 28 inches high from the floor to the top of the mattress gives satisfaction to the patient, though it is somewhat unhandy for the nurse at times. The kind of springs which I have found to give the least trouble from sagging in the middle, and thus causing backache, etc., and also the most easily cleaned and most durable, consists of chain and cross-chain lengths, with wire side line from each end of the bed and with spirals at the end of every separate chain (Fig. 6). The mattress (Fig. 4) that is probably the best for postoperative use

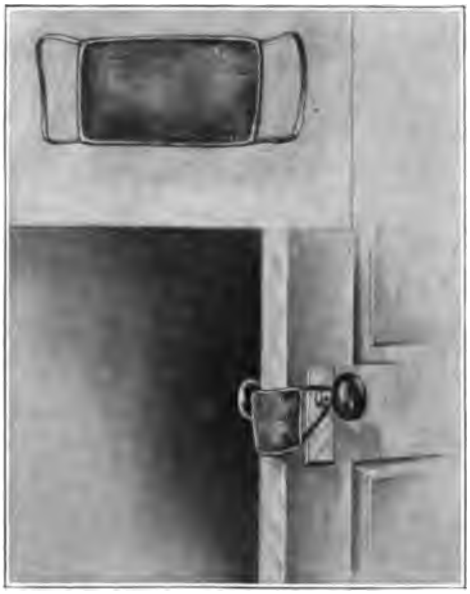


Fig. 2.—An antislamming device used at the Mayo Clinic.

is one made of curled hair. Pillows for arm or leg rests also made of this material, are desirable, since their contents can be washed or sterilized if contaminated with blood, etc. The ordinary feather

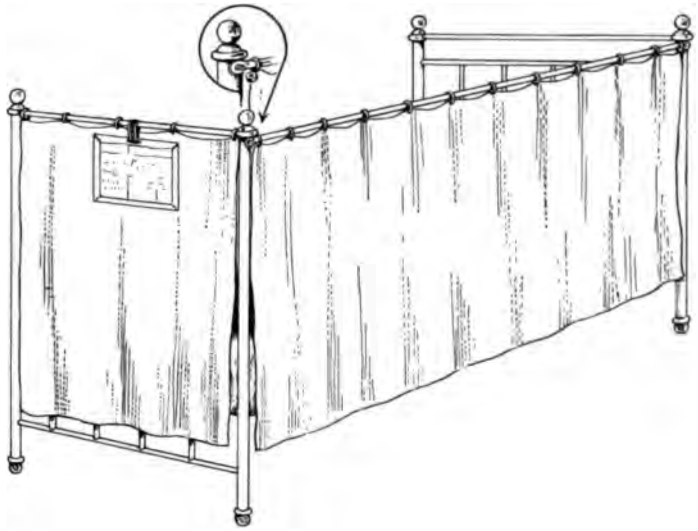


Fig. 3.—An iron bedstead used at the Mayo Clinic. The curtains are employed only where there are multiple beds in the same room.

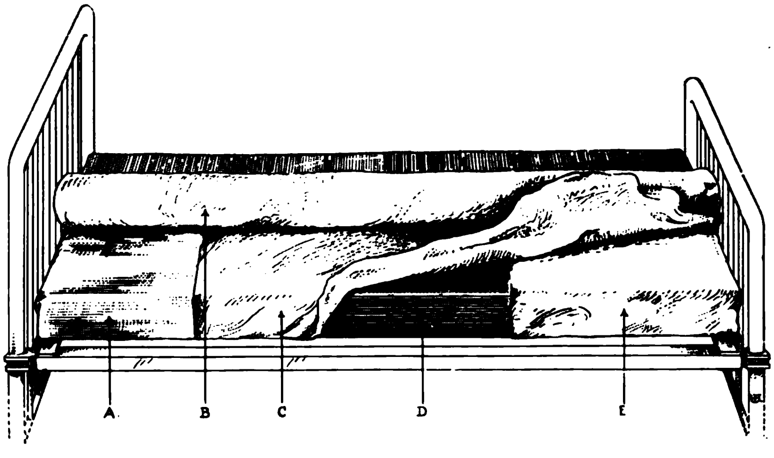


Fig. 4.—The ideal bed showing the mattress and the arrangement of bed clothes for the immediate reception of an unconscious postoperative patient.

A, Rubber sheet covered with linen sheet; *B*, sheet and two blankets rolled back; *C*, linen sheet covering whole bed; *D*, mattress; *E*, linen draw sheet.

pillow may be used for the head for the first few days; however, it can be encased in a rubber slip (Fig. 5) if the requirements of the case so demand.

A headrest (Fig. 6) may be built into the bed, or some homemade apparatus may suffice. The bed should be at least one foot away from the wall, since the air close to the wall is frequently stagnant. It should also be so situated that the foot is nearest the door, while the side is parallel to the windows, which best enables the patient to see out, and at the same time, to escape the glare of a direct light, and any draught which this would ordinarily entail. By opening the transoms above the windows and doors a freely circulating

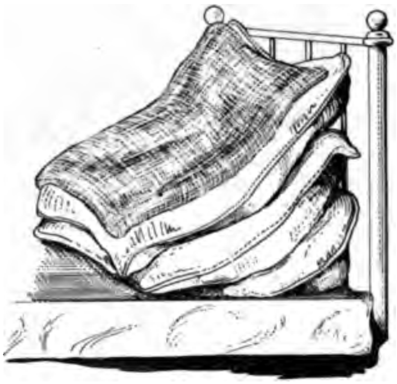


Fig. 5.—Pillows and rubber slips.

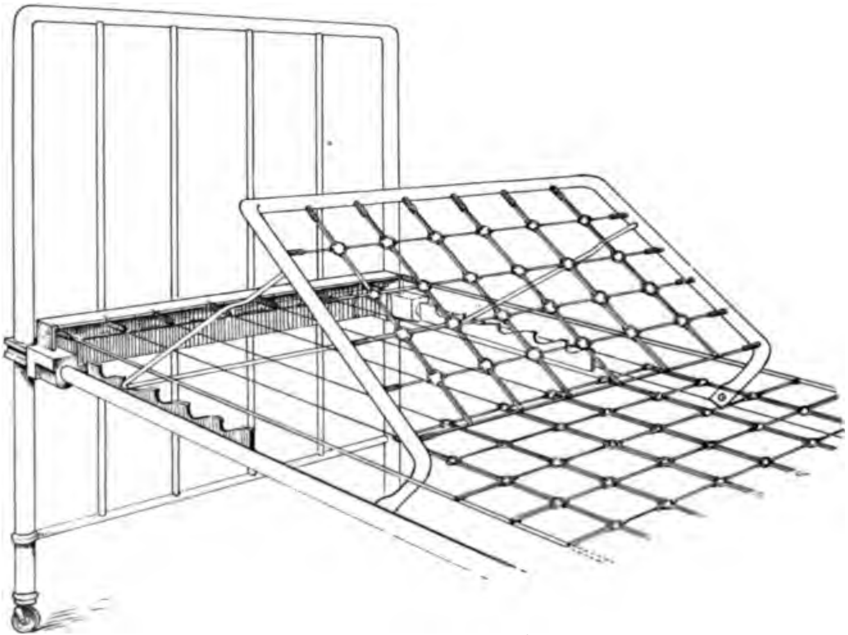


Fig. 6.—A headrest built in.

atmosphere can be obtained without unnecessary exposure of the patient.

In addition to the bed, a leather couch may be installed (if the size of the room permits) for the use of the nurse at night, or to allow the patient to rest during the day. A dresser with a large mirror is convenient. A small bedside table is very necessary for the immediate use of patient or nurse. A few vases capable of holding long-stemmed flowers may be held in readiness.

In rooms with the bath attached, every convenience is supplied for the toilet, but even in those not so equipped, a washbasin installed as a permanent fixture, or an ordinary washstand, is highly important. This is, however, separated from the rest of the room by a three-paneled screen with light green washable fillings. In most hospitals the largest rooms contain a spacious closet or wardrobe. This is a desirable asset, as many patients are particular about their clothes and other belongings, and to know they can be properly cared for eases the mind. A large, comfortable rocking chair, and two straight back chairs, with one footstool, complete the furnishings of a most desirable room for the housing of a surgical patient.

The above represents the absolutely *ideal* in its way, while, as a matter of course, the average surgical patient who makes a satisfactory recovery does so amid surroundings which are comparatively inexpensive and unostentatious.

CHAPTER II

RECORDS AND CHARTS

By Willard Bartlett, St. Louis, Mo.

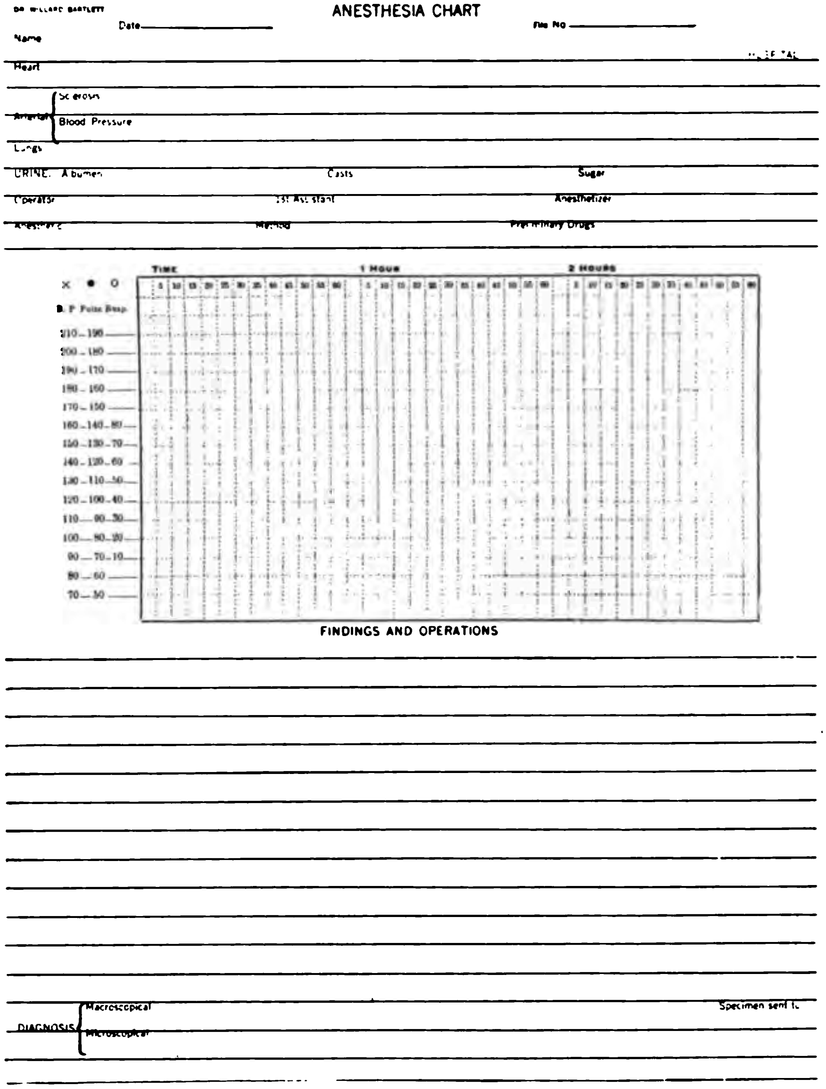
A graphic record, properly made out, especial attention being paid to the plotting of the various curves, enables the surgeon to orient himself more readily on the occasion of a visit, than is possible by any other means. Herein lies the chief value of hospital records from the standpoint of the patient. If this is a matter of importance for a single day, it becomes doubly so when a complication arises and the record of today must be compared with those that have preceded it.

Accurate records are of undoubted value in that they keep those who make them up to the mark. It is quite reasonable to think that the most useful records are made by the most observing physician or nurse, hence they assume importance when viewed as a part of our armamentarium which is used for purposes of instruction. One has only to mention the possibilities in the way of medicolegal value of accurate and legible records. In no other manner can a surgeon so definitely substantiate his impressions and statements as by referring to them. They have a further indirect value in this connection, as tending to show that painstaking care was exercised even though the result may not have been all that the patient could have desired.

Charts and records will vary in kind with the amount and scope of the work undertaken by the individual. It is quite obvious that the clinic which confines itself to private surgical practice will develop needs different from those of a teaching clinic which is conducted in the interest of medical students or postgraduate physicians; while the training of pupil nurses is also a factor to be considered, and the appearance of a chart will depend to no slight extent upon their native intelligence as well as upon their previous scholastic training.

I submit herein a number of sample charts which have developed in my own work, without assuming that they will perfectly meet the wants of every surgeon, but because I have found them exceedingly useful and hope that they may offer suggestions which will help the reader to develop a system which may exactly fulfill his own needs.

It is logical to suppose that the postoperative record of a case commences in the operating room just as soon as the wound has been closed. It is my custom to immediately dictate on the so-called *Anesthesia Charts* (Fig. 7) the findings and operations in the case under discussion. An assistant has previously filled out the headings and


DR. WILLARD BARTLETT

ANESTHESIA CHART

Date

File No

Name

Heart

Arteries: Sclerosis; Blood Pressure

Lungs

URINE: Albumen; Casts; Sugar

Operator; 1st Assistant; Anesthetizer

Anesthetic; Method; Preliminary Drugs

TIME
1 HOUR
2 HOURS
× ● O
B. P. Pulse Resp.
5 10 15 20 25 30 35 40 45 50 55 60
210–190
200–180
190–170
180–160
170–150
160–140–80
150–130–70
140–120–60
130–110–50
120–100–40
110–90–30
100–80–20
90–70–10
80–60
70–50

FINDINGS AND OPERATIONS

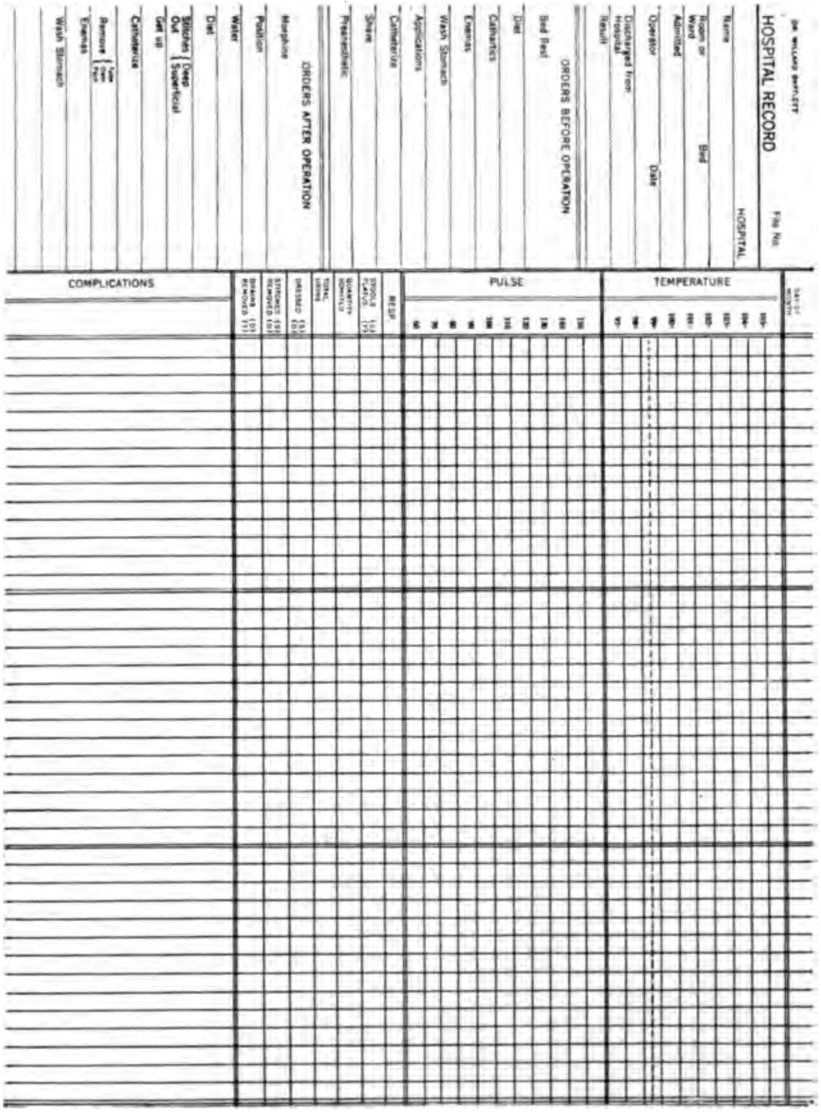
DIAGNOSIS: Macroscopical; Microscopical

Specimen sent to

Fig. 7.—Record of patient's condition, findings, and operation.

the anesthetist made observations during the time of operation which enable her to quickly plot pulse, respiration, and sometimes blood-pressure curves. There are many forms of chart used for this purpose but none seems to have found such extensive favor as the one presented.

In a modern clinic one is accustomed to do several operations in a day, hence, it is obviously impossible to keep in mind, until ward rounds are made, all of the therapeutic suggestions which present themselves during the progress of the operation. I have, therefore,



HOSPITAL RECORD

File No.

Name

HOSPITAL

Room or Ward

Bed

Admitted

Operator

Date

Discharged from Hospital

Result

ORDERS BEFORE OPERATION

Bed Rest

Diet

Cathartics

Enemas

Wash Stomach

Applications

Catheterize

Shave

Preanesthetic

ORDERS AFTER OPERATION

Morphine

Position

Water

Diet

Stitches Out { Deep / Superficial

Get up

Catheterize

Remove

Enemas

Wash Stomach

COMPLICATIONS

DRAINS REMOVED

STITCHES REMOVED

DRESSED

TOTAL URINE

QUANTITY VOMITED

STOOLS FLATUS

RESP.

PULSE

TEMPERATURE

DAY OF MONTH

Fig 8.—Postoperative orders.

long been accustomed at the end of each operation to dictate on the *Hospital Record* (Fig. 8) in the lines especially set aside for that purpose; *Orders after Operation.* Where but two temperature, pulse, and respiration observations a day are indicated, this form of chart will be found remarkably satisfactory. The amount of effort devoted to the recording of important items is reduced to a minimum; for

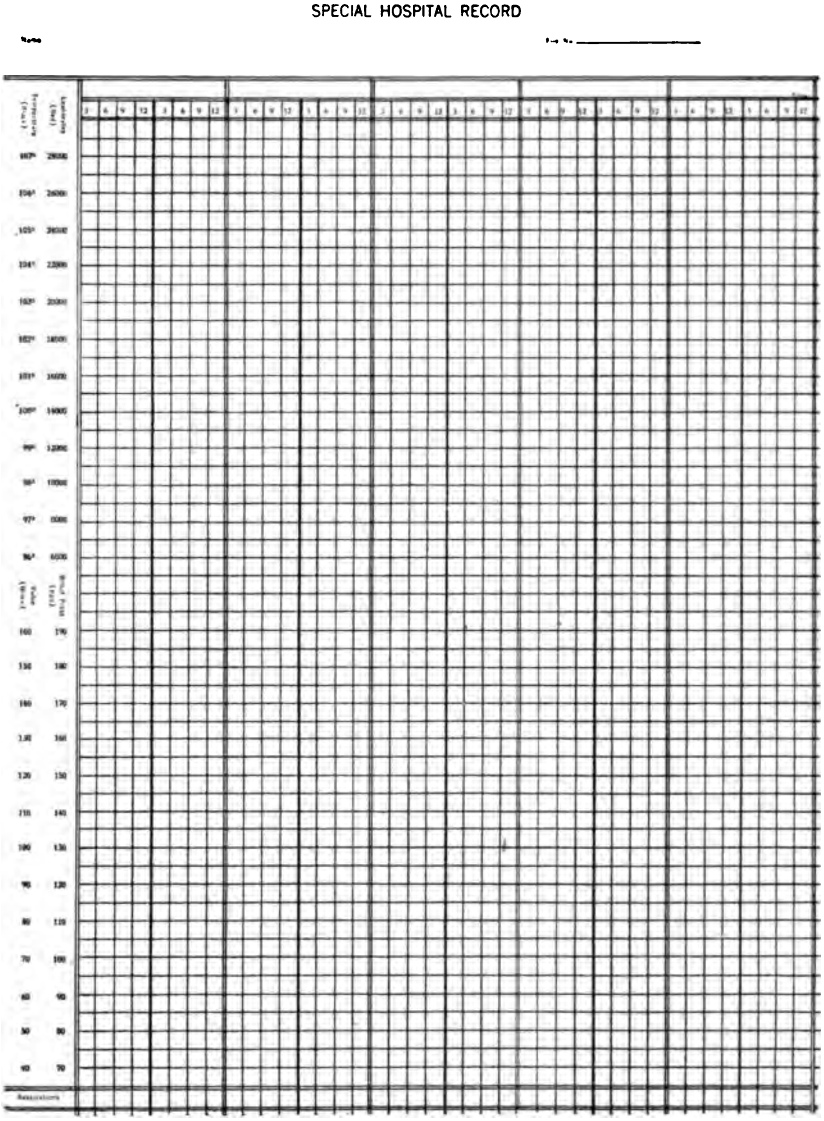
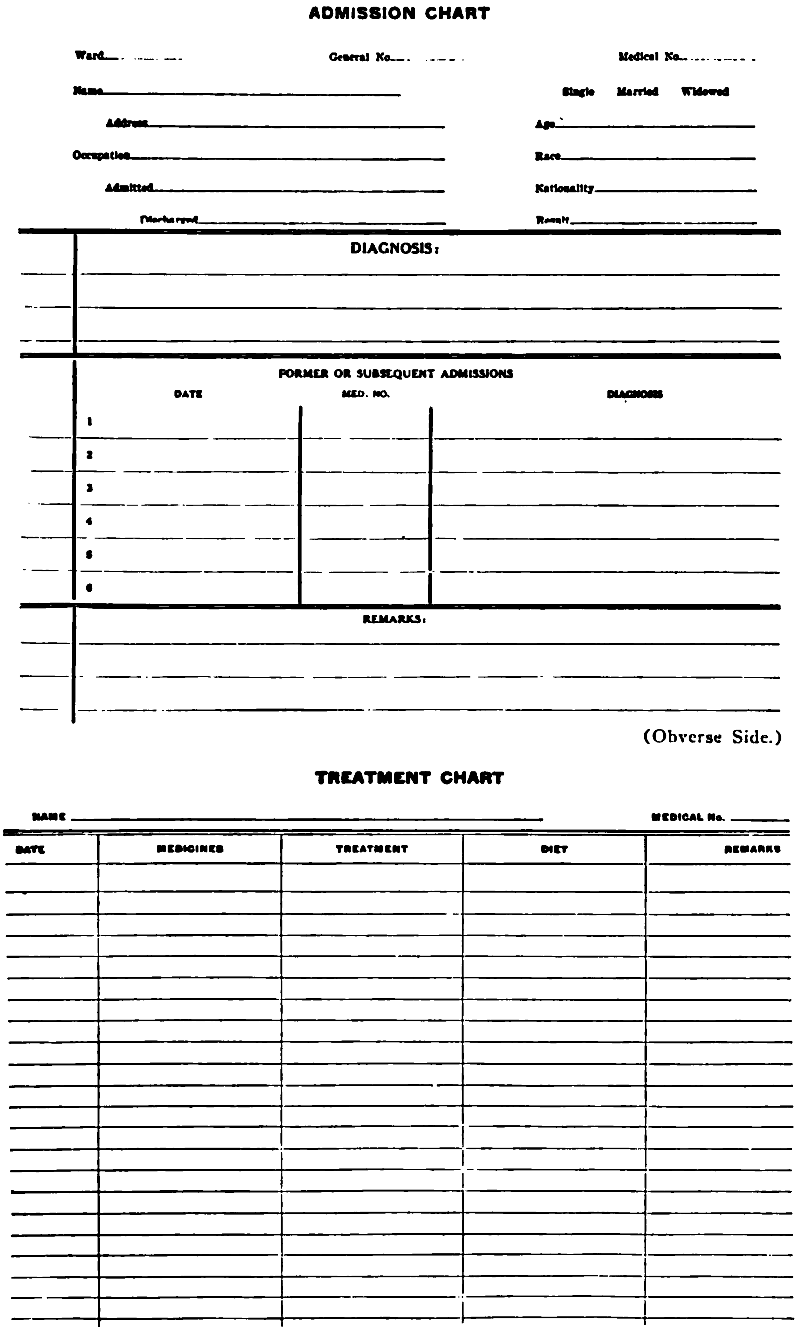


Fig. 9.—Chart for eight observations daily.



ADMISSION CHART

Ward______ General No.______ Medical No.______

Name______ Single Married Widowed

Address______ Age______

Occupation______ Race______

Admitted______ Nationality______

Discharged______ Result______

DIAGNOSIS:

FORMER OR SUBSEQUENT ADMISSIONS

	DATE	MED. NO.	DIAGNOSIS
1			
2			
3			
4			
5			
6			

REMARKS:

(Obverse Side.)

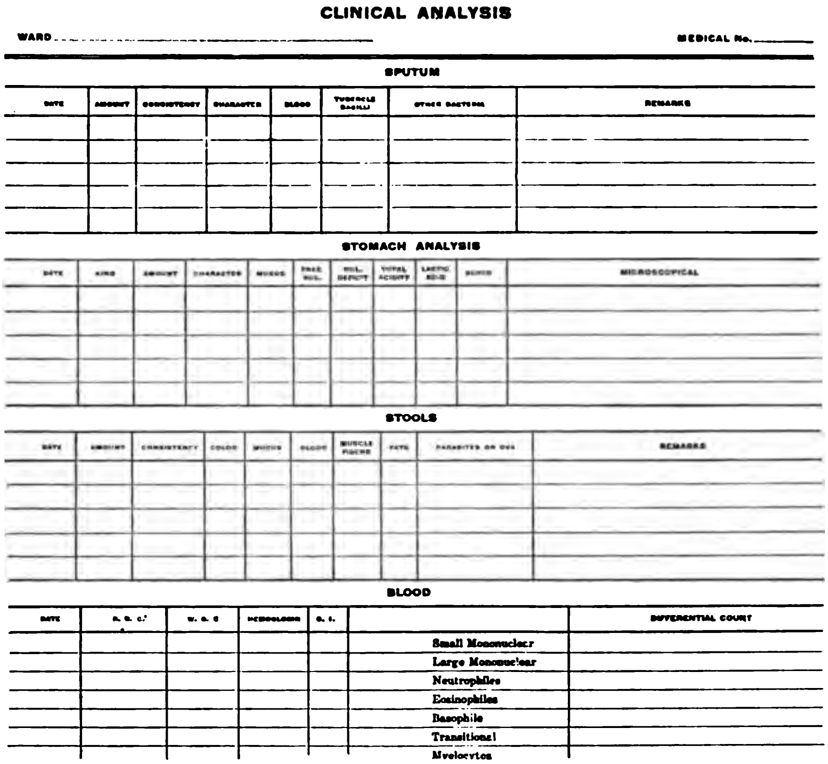
TREATMENT CHART

NAME______ MEDICAL No.______

DATE	MEDICINES	TREATMENT	DIET	REMARKS

(Reverse Side.)

Fig. 10.—Admission and treatment chart.
(Courtesy Hospital Standard Publishing Co., Baltimore.)



CLINICAL ANALYSIS

WARD ____________________ MEDICAL No. ________

SPUTUM

DATE	AMOUNT	CONSISTENCY	CHARACTER	BLOOD	TUBERCLE BACILLI	OTHER BACTERIA	REMARKS

STOMACH ANALYSIS

DATE	KIND	AMOUNT	CHARACTER	MUCUS	FREE HCL.	HCL. DEFICIT	TOTAL ACIDITY	LACTIC ACID	BLOOD	MICROSCOPICAL

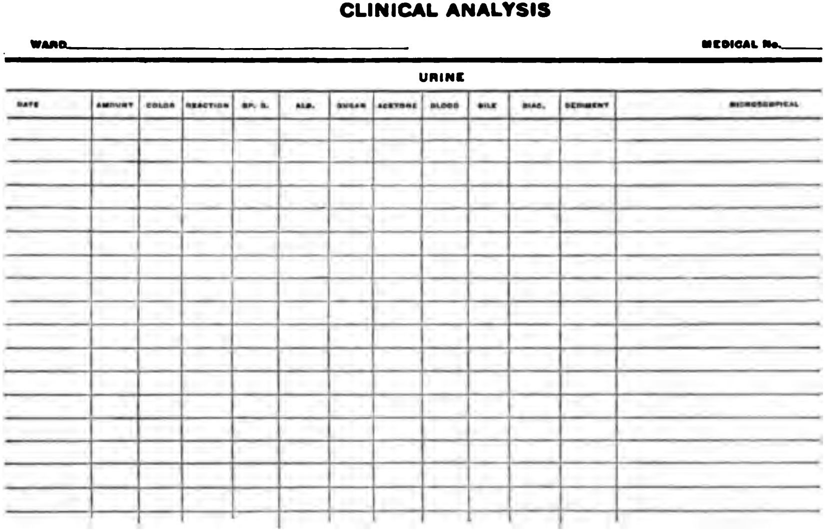
STOOLS

DATE	AMOUNT	CONSISTENCY	COLOR	MUCUS	BLOOD	MUSCLE FIBERS	FATS	PARASITES OR OVA	REMARKS

BLOOD

DATE	R. B. C.	W. B. C	HEMOGLOBIN	C. I.		DIFFERENTIAL COUNT
					Small Mononuclear	
					Large Mononuclear	
					Neutrophiles	
					Eosinophiles	
					Basophile	
					Transitional	
					Myelocytes	

(Obverse Side.)



CLINICAL ANALYSIS

WARD ____________________ MEDICAL No. ________

URINE

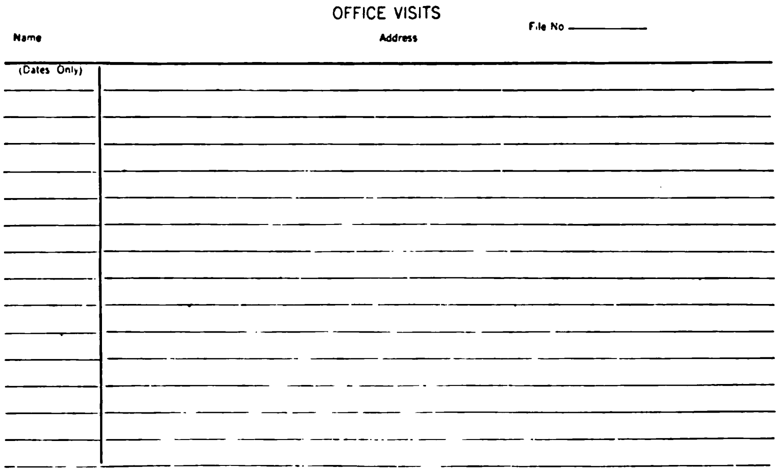
DATE	AMOUNT	COLOR	REACTION	SP. G.	ALB.	SUGAR	ACETONE	BLOOD	BILE	DIAC.	SEDIMENT	MICROSCOPICAL

(Reverse Side.)

Fig. 11.—Clinical postoperative laboratory record.
(Courtesy Hospital Standard Publishing Co., Baltimore.)

instance, the scratch of a pen is sufficient for noting stool, passage of flatus, quantity vomited, total urine, change of dressing, removal of stitches, or the withdrawal of drains. Under *complications,* space is given for the insertion of the somewhat rare though extremely important words—distention, sleep, pain, delirium, menstruation, hemorrhage, discharge, unconsciousness, sweating, involuntary urination and defecation, etc. The reverse side of this sheet is ruled and at the top is printed *Operator's Notes.*

Where more detailed observation, especially during inflammatory processes, is indicated, I maintain what is termed a *Special Hospital Record* (Fig. 9) which permits curves to be plotted, showing rise or fall in temperature, pulse, leucocytes, and blood pressure every three hours. I have not maintained for several years the old-fashioned bedside notes, which were once so universally used. If further information is deemed of value I would suggest a so-called *Treatment Chart* (Fig. 10) which allows the recording of medicines, treatment, and diet, along with a column for remarks which can not be classified.



OFFICE VISITS

Name

Address

File No

(Dates Only)

Fig. 12.—Record of posthospital examinations of simple nature.

There are many cases involving the gastroenteric tract either directly or indirectly in which the surgeon can keep his bearings only by the use of an *Intake and Output Chart.* It is especially true where there are grave nutritional changes or in obstruction of the bowels, or where peritonitis prohibits the use of the intestinal tract for the disposal of fluids which must then reach the circulation in some other manner.

It is desirable in not a few instances to make repeated examinations of the urine which can, I think, be of the greatest possible value only if recorded on some form of chart similar to the one entitled *Clinical Analysis* (*Urine*) (Fig. 11). A comparison of results is thus much more easily possible than if the most painstaking investigations are recorded on separate sheets of paper.

In private practice I record every observation of the patient subsequent to his leaving the hospital upon a rather convenient card entitled *Office Visits* (Fig. 12). Three months from the day of the operation, and again twelve months from the same date, the patient receives a letter asking detailed information about his condition and is urged at the same time to write us any questions which may have arisen in his own mind. Every reply to these epistles, as well as all other communications in reference to a certain individual, is kept in a folio devoted to his history and hospital records. Surely no clinical record can be considered complete when the patient leaves the hospital, hence the value of some kind of follow-up system is now impressing itself more and more in many of our leading hospitals.

CHAPTER III

PRELIMINARY CONSIDERATIONS AND ANESTHESIA

By O. F. McKittrick, St. Louis, Mo.

The outcome of the postoperative course depends so much upon the proper selection, examination, and handling of the prospective operative patient that we are forced to discuss several problems the correct solution of which is essential to successful work in this field. Constant and studious attention to this phase of surgery has done more to eliminate the complications which may arise later than has any other one thing at the disposal of the man in whose charge the patient is placed after the operation.

In "pulling through" the supposedly hopeless cases, by efficient and painstaking after-care, one is impressed by the prompt reaction exhibited in some cases, while in others, all efforts are seemingly of no avail. In every instance where interest in the welfare of the patient has incited sufficient attention to preliminary considerations, uncalled for and unnecessary complications are avoided, which, unfortunately, are often seen in the patients not receiving these considerations.

The selection of the patient to be operated necessarily rests, in private practice with the individual surgeon, and the *error* of having interfered surgically in an inoperable case, should always be considered before the postoperative treatment is criticized. An examination, independent of the surgical condition, must be made of the lungs, heart, and kidneys. For the busy surgeon, this usually consists in an ordinary physical examination as outlined by Cabot,[1] for instance. Other examinations, such as blood pressure, hemoglobin, and clotting time of the blood, are also desirable, and in many cases, imperative. The thoroughness and extent of the examination depends upon the condition of the individual patient. So also is the method of procedure influenced by the nature of the findings. Any abnormalities are rectified so far as possible, and the extent of the operative procedure determined. Old, debilitated patients are fed and given large amounts of water under the skin, if necessary. The excitable goiter patient is calmed as much as can be done by diligent care, rest, and medication, and the highly acid urine reduced by large quantities of alkalies, in addition to forced water. No patient, except in dire necessity, is operated in the presence of an acidosis. It follows then, that a high blood pressure is reduced by proper rest and elimination, so long as no untoward results are obtained by so doing, and the diastolic pressure remains relatively normal. It may be added that a hemoglobin below 30 per cent was considered by Mikulicz[2] as being unsafe for a general anesthetic, while Keen,[3] Da Costa and Kalteyer[4] would consider 50 per cent as the lowest limit. It has been shown repeatedly that ether narcosis produces a decrease in the hemoglobin,[5] and this fact alone is sufficient to force painstaking consideration of the anemic patient. It has also been determined that the resistance of the body to bacterial invasion is lowered in that ether decreases the phagocytic power of the blood. Therefore, operations on patients with lowered vitality are deferred as long as the surgical condition will permit, and medical treatment is given to increase the general strength.

The successful preliminary handling of the individual about to undergo an operation is not always an easy task. The general preparation for individual cases can not be gone into here, but in the main, it may be said that those patients whose physical findings do not warrant special measures are sent to the hospital the morning of the day before the operation. On admittance they are given a warm tub bath, and provided with a gown which opens down the front and is made of heavy or light material, depending on the kind usually worn by the patient, as well as upon the season. Cathartics are no longer employed indiscriminately, but the bowels are moved before bedtime by enema as a rule. A pitcher of water is placed beside the bed, and about one glassful is ordered for every waking hour, and in addition, an extra one to be taken an hour before the operation. The field of operation is prepared and those who are strong enough and desire to do so are allowed to sit up out of bed, so as not to decrease the chances for a good night. If necessary, veronal, 5 to 15 grains, is given in a glass of hot milk at the evening meal. The evening meal is light and consists chiefly of carbohydrates. It may be advisable to employ aspirin, 10 grains, and codeine, 1 grain, one hour before bedtime if there is any pain or general restlessness.

In the morning the patient is rarely allowed out of bed, gets a light breakfast of rice or barley gruel (if the operation is not to be too early), and in rectal cases, an enema of soap suds is given. The patients that do not receive the usual hypodermic of morphine and atropine are allowed to walk to the operating room. At the Mayo Clinic, where the preanesthetic is not often given, the patients, while waiting their turn to be operated, are ordinarily permitted to mix freely in a room set aside for this purpose, and the importance of the coming ordeal is minimized by conversation with others. When the operation takes place before the middle of the morning and preanesthetic drugs are used, the patient is kept in bed, no breakfast being given, and is wheeled to the operating table. *In either event, water is given freely to within one hour of the operation.*

In giving preliminary medication we have followed out the admonitions of Gwathmey[6] that it should not be used—except in rare instances—in the "extremes of life (under seven or over seventy); acute or subacute nephritis; a state of coma; in cases where morphine is taken with distress or with disagreeable after-effects and especially in cases of idiosyncrasy; also in very weak and feeble patients and in those with respiratory affection." In such cases atropine alone may be given, 1/150 to 1/100 grain, thirty minutes to one hour before the operation, as a rule we employ no medication at all when we give no morphine.

The administration of morphine 1/8 to 1/4 grain, combined with atropine, 1/150 to 1/100 grain, is not employed as a routine even in cases that do not fall within the scope outlined above. Such is given hypodermically in selected cases in whom its effects are particularly desired. The good results obtained in such cases are due to the increase of confidence aroused in highly nervous or excitable patients, the lessened amount of ether required, and the decrease of mucous accumulation in the throat. The dose enables the patient to go to sleep quickly and easily, and in many instances allows him a more pleasant recovery from the anesthetic. Often in alcoholics or patients not going under ether normally, an additional hypodermic of morphine 1/6 grain is given after the anesthesia or the operation has been started.

The objections to such medication in many cases should be sustained. Herb[7] states that "morphine allays the reflex excitability of the air passages, thus retarding coughing and favoring the retention of aspirated blood or vomitus in the trachea or bronchi, which predisposes to pneumonia. Many people are unable to take morphine without distress or vomiting and in such individuals the disagreeable after-effects of ether would be aggravated." She also notes that in cases of accident not only is the volatile and quickly removable poison ether to be eliminated, but also the nonvolatile morphine. She reminds those men who give atropine for the excessive mucus that the same can be easily taken care of if the head of the unconscious patient is turned to one side and it is allowed to run out at the angle of the mouth.

The promiscuous giving of such medication, no doubt, is to be deplored, yet the absolute denial in every case can not be countenanced. Sanders,[8] resident surgeon at St. Mary's Hospital, Rochester, Minn., stated that so far as he could see there was absolutely no difference in the results obtained by those operators there who never used preliminary medication and by those who used it routinely.

The operation should be performed as early after 7 A.M. as is compatible with convenience. Such a procedure reduces to a minimum the results of the mental agitation which every patient undergoes to some extent. The factor, *fear,* plays a more important role than is commonly surmised. Gwathmey[6] states that over 70 per cent of cases require mental as well as medical treatment to insure the most satisfactory results. He further quotes Keen,[9] who says that "patients whose thoughts are made to run in pleasant channels as the anesthetic is first given usually take the drug more quickly than do those who inhale it in a condition of mental distress. This is particularly true of nervous women and children. When the fears of a patient who is conscious are developed into the terrors of semiconsciousness, in which the patient imagines the most frightful accidents are taking place, it can be readily understood that profound nervous shock is produced." Such a state of mind does not arise alone from the most serious operations but even those of a trivial nature may have the same effects. Often there is no outward sign of this mental state, and the patients may stoutly deny its presence until an examination of the pulse alone reveals the condition. Children and nervous women are not the only sufferers from the fear of the anesthetic. Strong and robust men are frequently to be added to the list. In this connection it may be added that among the cases reported in which death occurred as a result of such psychic stimulation, the majority were men.

In this connection it may be instructive to recall Bloodgood's[10] case in whom fear of the anesthetic alone caused a fall in blood pressure from 140 to 80 mm. mercury in ten minutes. One of the most striking examples, however, is a case reported by Probyn-Williams.[11] "A nervous boy nine years old, was placed on the operating table preparatory to removing his tonsils and adenoids. The mask was placed over his face and a relative held his hand. Suddenly and before a particle of the anesthetic was dropped on the mask, the patient began to breathe rapidly, drumming with his heels on the table, and saying 'I'm going.' The mask was taken off and attempts made to quiet him, but in a few moments he was dead.

Nothing was found to account for the phenomena except the fear which he had experienced."

In view of such statistics no opportunity should be lost in endeavoring to eliminate any mental disquietude which a patient undergoes during the preparation for even the simplest operation.

Anesthesia at its best furnishes the only unpleasant recollection of the operation for many patients. A well-trained anesthetist can do considerable towards making the procedure more endurable and should in every instance be retained. He should become acquainted with the patient as soon as he is admitted to the hospital and every effort be made to gain his confidence and friendship. Such treatment will go a long way toward eliminating the fears and misgivings which arise in the mind of the patient as he waits in the hospital for his call to the operating room.

During late years women anesthetists, usually trained nurses, have been employed in the largest clinics in this country and the practice has been upheld and even advocated by many of the latest writers. Personally I feel this a good practice, especially if she lives in the hospital and can see the patient frequently. She is more expert than a man in soothing the excited patient especially a female or child, and the male patients will brace up and become men in her presence. Nurses are sympathetic, gentle, quick to observe small details, and the love for the work which is a step higher than their chosen profession urges them on to exhibit every feminine trait which is most serviceable to the individual about to pass through one of the most important periods of his life. During the operation itself she devotes her entire attention to the anesthetic while the lure of the surgical field does not exist for her. The operation, therefore, is watched just enough to inform her as to the amount of anesthetic to be given. Certainly if all women anesthetists were like Florence Henderson at the Mayo Clinic, no objection could be raised against them. On the other hand, a doctor, because of his training alone, has a certain advantage over the nurse. Men who make this work a study and who have natural ability along this line, though rare, are certainly the more desirable. They are not so apt to become confused in emergencies and are generally recognized as more stable than the woman whose physical makeup forces her disposition to be more or less uneven. Keen stated that "personality, intelligence, zeal, and quick wit may easily be worth more than greater knowledge," and suggests that a *woman physician* would be ideal. No doubt he is right, provided such a physician as he mentioned could be procured, take for example, Dr. Isabel Herb of Bevan's Clinic. However, the ambitions of women doctors to become surgeons may cause them to use anesthesis as a "stepping stone" to surgery as Keen suggested, and thus defeat the very purpose for which they are intended. The selection like so many others of its kind in surgery must necessarily rest with the individual surgeon.

The preliminary treatment having been carried out, the patient is brought to the operating room. The stomach and the bladder are empty. The mouth having previously been examined by a dentist and all loose, useless teeth removed, and the mouth cleansed repeatedly with some mouth wash until the time set for the operation, the individual puts himself in the care of the anesthetist. He is now placed on a well-padded table and amply protected from chilling by sufficient covering as directed by the expert anesthetist. The position of the patient varies, of course, according to the operation. At all times it should be as natural and comfortable as possible, allowing free respiration and circulation. Now is the time to think of nerve injuries which may develop during the after-care and attempt to *avoid* them by placing the body and limbs so as to escape undue strain or pressure. The usual position is that as shown in the figure above. Backache is anticipated by placing a pillow under the dorsal curve of the spine before the anesthetic is started. A strap is finally placed over the limbs as shown in Fig. 13, and the anesthetic started.

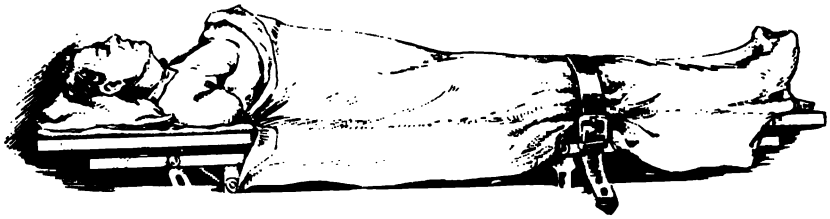


Fig. 13.—Position of patient on operating table showing restraining strap across lower limbs.

The choice of the anesthetic can not be discussed here but there are a few points which deserve attention. It has been found that in the vast majority of cases ether alone can be used with greater safety and efficiency than any other anesthetic or combination of them. In some instances gas and ether or gas alone has been employed. In most instances, however, where ether is not desirable, the local anesthesia makes a most excellent substitute. The details of the anesthesia (Fig. 14) are best described in special works on this subject, although a word along this line would not be amiss.

Often a patient asks to see the surgeon at the last moment and wants a friend or relative near as he is about to begin the inhalation of the ether. In my opinion these simple requests should be indulged provided asepsis be not prejudiced thereby.

Preliminary medication having been employed the patient is in a frame of mind to receive kindly admonitions and encouragement from the anesthetist who will not neglect to use all the powers of hypnotic suggestions he or she possesses, while ether is slowly dropped on the mask (that devised by Ferguson is preferred by me).

It is the custom of some anesthetists to protect the eyes with a dumb-bell-shaped piece of gutta percha over which is placed a layer of wet gauze as advised by Fowler.[12] Others do not employ any covering, stating that such will only cause ether fumes to remain in the proximity of the eyes and thus cause irritation, when if they are left open, the air quickly carries the fumes away. In each case the anesthetist should use his own judgment. It is needless to say that all precautions are taken to see that no foreign bodies are left in the mouth; of course, false teeth, chewing gum, etc., are taken out. No unnecessary noise or talking is allowed in the room while the patient is still conscious; the patient gets the full benefit of anything said to him, and at no time is it allowable for him to be left alone for even a moment. A table containing the mouth gag, tongue forceps, towels, basin for unexpected vomiting, strips of gauze, and anesthetist's chart

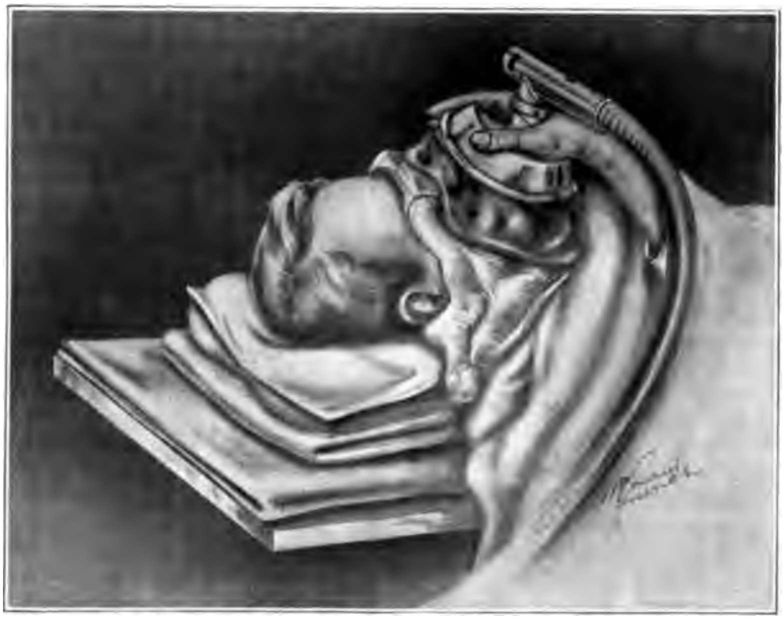


Fig. 14.—A mask which is widely used for the administration of gas and ether combined.

is placed within reach. As the patient goes under no one is allowed to restrain him or speak to him other than the anesthetist. How often have we seen a restraining hand during an otherwise uneventful anesthesia produce in the patient the wildest delirium, and in every instance the induction of narcosis was delayed!

As soon as the patient is ready for the operation the head is turned to one side in order to facilitate the outflow of mucous and a strip of gauze slipped between the teeth and the cheek until one end reaches the last molar tooth, the other end hangs outside of the corner of the mouth. The gauze not only drains excessive fluids from the mouth, but also acts as a plug against Stenson's duct, and therefore inhibits to *some extent* the flow of saliva.

During the etherization the blood pressure is taken off and on if occasion demands it. As shown by Harner,[13] the blood pressure is of greater value in determining the condition of the patient than the rate and quality of the pulse and gives warning of danger five to twenty minutes earlier.

Constant even anesthesia is naturally desired; viz., one which keeps the patient at all times well under, yet never in too great danger of respiratory failure. With well-trained teams one will notice the anesthetist stop giving ether when the rectum is being dilated or at such a time in the operation that the operator in putting in the skin stitches will frequently awaken a marked reaction, after which the patient can be half aroused by the time he is back in bed.

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CHAPTER IV

FROM TABLE TO BED

By O. F. McKittrick, St. Louis, Mo.

Immediately after the operation and during the time the final dressings are being placed by the surgeon, the restraint straps are taken off the patient and all blood and perspiration quickly removed from the surface of his body and his gown replaced by one which has been in contact with a radiator throughout the operation. In the meantime the soiled linen in immediate contact with the patient and covering the operating table is pulled from under him and replaced by warm dry, clean sheets. A small blanket being hastily thrown over him, he is gently lifted by two or three assistants and placed upon a stretcher bed, mounted on a four-wheeled cart. In preparing to lift the patient care is taken to first gently roll him towards the assistants, in order that he may be supported by their arms rather than by their forearms. Otherwise too great pressure will be exerted here and there by their hands, which may cause areas of soreness or other discomfort to develop later.

Any unnecessary pulling or jerking of the patient must be avoided as such treatment predisposes to vomiting in the semiconscious individual. Also the horizontal position is to be maintained if possible. Sudden elevation of the head will then be avoided and the danger of syncope very much lessened. It may be well to add here that if, for any reason, it is necessary to *carry* the patient to the bed, the head of the stretcher is not elevated and in going upstairs the *foot* is taken first while in going down stairs the *head* goes first.

One of the best methods employed to remove a patient from the operating table is that which utilizes two long poles which support two pieces of heavy canvas (Fig. 15). These are placed beforehand on the operating table and protected with a rubber sheeting which is then covered by the regular linen sheet. The patient then lies indirectly upon the canvas supports during the operative procedure. The piece used for the upper portion of the body is twenty-seven inches long, twenty-seven inches wide and contains on either side two separate spaces which will allow a large pole, one and one-half inches in diameter, to pass through. The outside space is used for large patients, and the inner space for smaller individuals. The other piece is thirty inches in length, being twenty-seven inches at the top and twenty-three inches at the bottom. It also contains the spaces for the lifting pole, as described for the larger piece. When the patient is ready for the stretcher, the poles, which are seven feet long, are slipped through the spaces prepared for them, one on each side of the patient, and he is easily lifted onto the stretcher by two assistants without danger of the slightest injury. The poles can then be slipped out or left in position and carried on the cart to the bed, where the process is repeated.

The stretcher (Fig. 16) which receives the patient is prepared beforehand so that no time is lost in getting him ready for his ride to the bed. In consists of a mattress pad which completely covers the top of the cart. This mattress is two inches thick and is made of curled hair encased in rubber sheeting. Over this are placed two double half blankets, one within the other, so that the blanket which covers the mattress also covers the middle blanket. This second blanket and the upper half of the first blanket are folded back upon themselves and kept in readiness at the foot of the stretcher. Two towels present themselves, one in the center and the other at the head of the stretcher, for the protection of the bottom blanket from the vomiting, perspiring, or bleeding patient. Over the center towel is placed a binder, or a binder with a T-strap attached and opened

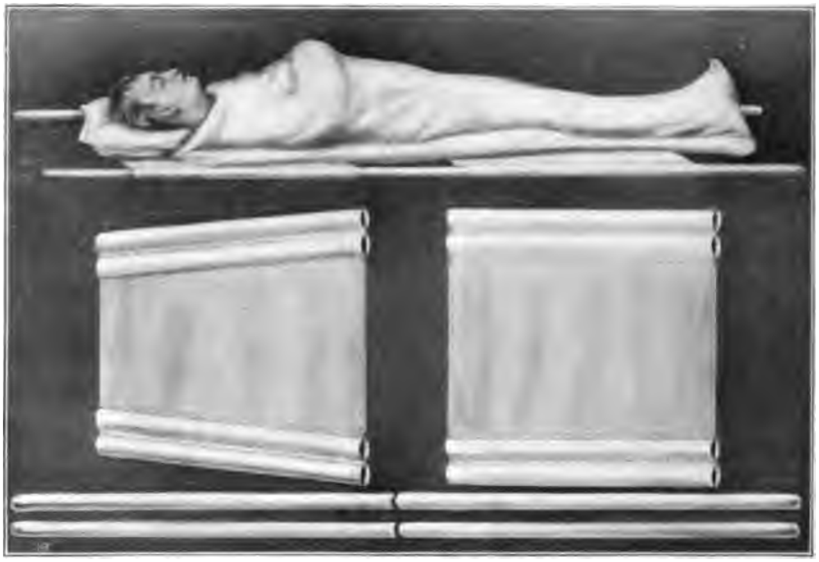

Fig. 15.—A convenient way of transferring the patient from the operating room to the stretcher or ward carriage.

out ready for use in those cases which require these assets. At the corner, near the head, two other towels are retained for instant demand. A pillow is unnecessary.

The patient having been laid on the stretcher, the operating room blanket which accompanied him from the table is discarded and the roll of blankets at the foot of the stretcher quickly brought over him. The binder is now fastened over the surgical dressing around the abdomen and pinned with safety pins, the slack on the sides being obliterated by these same means. The blankets are tucked around him, the cranium and face covered down to the nose with one towel, the chin and neck with the other, and the journey to the room is commenced.

A recovery room is very desirable. Instances of postoperative pneumonia and other lung complications are more often seen in patients who are wheeled through a long corridor, while those not thus exposed more often escape. However, I consider that most hospitals do not have this luxury, and therefore think of the patient as deprived of its benefits.

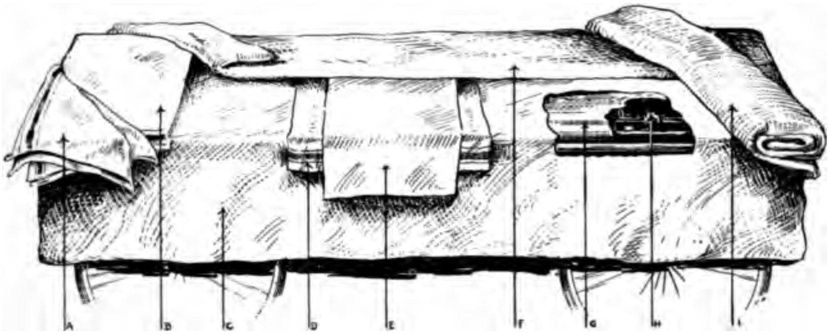

Fig 16.—Ward carriage ready to receive patient from operating table.

A, Towels folded back for instant use; *B*, towel; *C*, blankets; *D*, towel; *E*, binder (usually with T-strap); *F*, blanket; *G*, linen sheet; *H*, rubber sheet covering mattress; *I*, blankets.

On arriving at the room, the *foot* of the cart is pushed next to the *foot* of the bed, if the poles have been retained (Fig. 17A) and are to be employed in lifting the patient from the cart. The procedure is not very practical unless the head of the bed is low and the stretcher carriers can stand at the head and foot of the bed, respectively, while placing the patient in bed. If this method is not considered and the patient is to be lifted from the cart and then placed into bed, the head of the cart must first be placed next to the foot of the bed (Fig. 17B). The orderlies, standing between the bed and the stretcher, then lift him as before, simply turning around with the patient during the procedure of putting him to bed. It should be impressed upon those handling such individuals to bear in mind that inconsiderate holds and rough handling may cost the patient many days of suffering from bruised muscles or strained ligaments. This is at no time a procedure requiring so much haste that proper attention can not be exercised in giving firm and careful support to the unconscious human load as it is placed (not dropped) upon the bed.

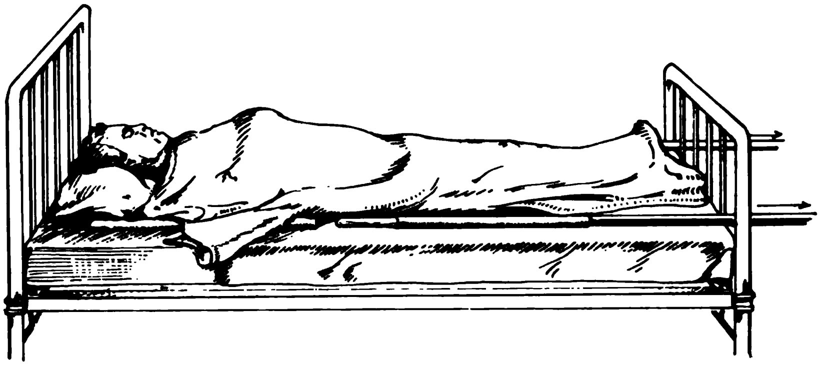

Fig. 17A.—Patient just returned from the operation. Apparatus shown in Fig. 15 was used as described on the preceding page. Poles are withdrawn in the direction of the arrows.

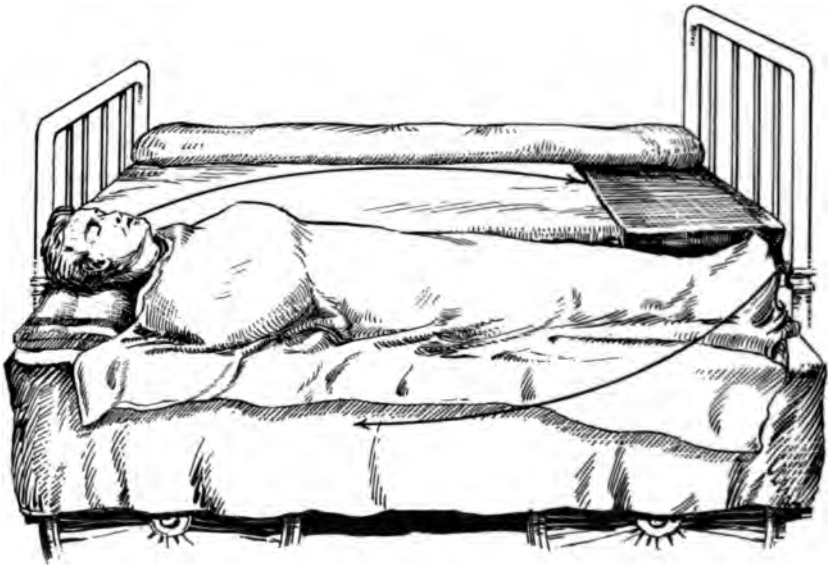

Fig. 17B.—Position of patient prior to being lifted into bed as described in the text. Head and feet will travel in the direction of the arrows during the maneuver.

CHAPTER V

IMMEDIATE EFFECTS OF ANESTHESIA AND OPERATION

By O. F. McKittrick, St. Louis, Mo.

The *immediate dangers* and attendant results of anesthesia or operation or both, can not be lightly passed over without some word of comment, since later complications which arise in the after-care can often be attributed to unusual happenings during the time the patient was in the operating room or immediately thereafter.

In such instances the two great systems which chiefly concern us most are the respiratory and the circulatory. *Respiratory difficulties* may be due, according to Probyn-Williams,[1] "to local or central causes. Of the former, obstruction to breathing may arise as a result of the lips and cheeks falling together during inspiration especially noted in the aged without teeth. The tongue, large tonsils or adenoids may also cause serious impairment to the ingress of air. Anatomic abnormalities, inflammatory swellings in the mouth, nose, larynx, trachea, or bronchi, must always be considered when trouble presents itself and preparations undertaken to overcome them by the use of the nasal tubes, intrapharyngeal tubes or in particularly serious cases, intratracheal anesthesia." "The first half hour is the period of greatest danger," says Keen, and during this time the anesthetist will have decided on the method best to be used and have it employed by the time the surgeon is called.

Difficult respiration often occurs from inspired vomitus or blood. I have seen it repeatedly in patients who, because of the urgency of their operation, could not be properly prepared for the operation, and even in a few patients who were prepared. On one occasion complete closure of the larynx occurred from inspiration of an adenoid which had just been cut off and the life of the patient was saved by quick dislodgment of it. Another patient, not so fortunate as was told me, was choked to death by a gauze pack which had slipped out of a cavity communicating with the mouth and following etherization suddenly plugged the larynx.

Mucus becomes troublesome at times. It alone has caused serious obstruction to free ingress and egress of air, and, in fact, it is a common factor which presents itself during this period. Frequently I have seen an excessive amount occurring even in patients given the preliminary atropine, which tends to decrease its production. Keen tells of three of his patients who almost drowned by the sudden "inundation of mucus." His first was a boy three or four years old who, after the operation began, started "loud bubbling respiration" and became cyanotic without definite cause. He was at once turned upside down by holding his heels and "frothy watery mucus poured in a stream from his nose and mouth." The operation was then continued successfully. His two other cases were adults whose lives were saved by resorting to similar measures. In the former instance a man was placed head downwards by the anesthetist mounting the operating table and holding him up by the legs while in the latter case the Trendelenburg position was utilized by elevating the foot of the operating table. Keen's treatment of these cases is certainly worthy of remembrance, and may be applied in the early postoperative period.

Fowler states that such accidents result from too rapid administration of ether. Certainly any acute inflammatory condition of the nasal passages will tend to increase the flow of mucus, hence if for no other reason, a general anesthetic should not be given in such cases.

Another local cause for obstructed respiration is *spasm* of laryngeal muscles which causes a closure of the superior aperture of the larynx. Buxton[2] states this is especially apt to occur in inflammatory states of the mucous membrane. The cause of the condition may be due to the irritating ether or some foreign body or bodies coming in contact with the sensitive mucous membrane or due to reflex action incited by operation procedures on other parts of the body.[1]

It should be noted also that difficult respiration occurs not infrequently from faulty position of the patient on the operating table, from assistants leaning on the patient, too tight bandaging of the chest or pleural exudates and that an increase in intraabdominal contents such as large tumors, ascites, etc., at times are very serious impediments to the free use of the chest and consequent perfect aeration of the lungs.

The *central* cause of respiratory failure is due to direct affection of the respiratory center in the medulla, whether it be a part of a general break-down of the circulation from shock or from loss of blood does not materially matter, since the treatment in either event will be much the same.

The general treatment of respiratory disorders consists first in securing a free air passage for the patient. This is best accomplished by one who is acquainted with any abnormalities the patient may have before the anesthetic was started. If none exists, the condition may have arisen from some foreign body which can be quickly removed. Simply holding up the jaw may be all that is necessary, and occasionally the tongue may have to be pulled forward with a piece of gauze wrapped around the finger. If the breathing has stopped and the patient is becoming cyanotic, the mouth is forced open with the gag, the epiglottis is lifted by the finger, and rhythmical traction on the tongue is started. There may be some difficulty in securing the tongue. In such instances rhythmical tractions on the neck will have the same effect. The head is grasped from behind and the neck is stretched backward and forward twenty to thirty times per minute.[3] If the patient does not quickly respond to this treatment Sylvester's method is at once resorted to. This consists principally in increasing the dimensions of the chest by raising and lowering the arms. The head is lowered and the arms are first pulled forwards, which causes forced inspiration. The arms are now brought down to the sides, being flexed as they descend, the elbows finally to be utilized in compressing the chest. The maneuver is repeated 18 to 20 times a minute. If there are sufficient assistants, the rhythmic traction on the tongue may be employed as well as pressure on the abdomen at the time the elbows are being compressed against the chest walls.

If the respiratory failure is due to obstruction by some foreign substance, the patient is at once inverted as suggested by Keen,[7] and in addition, direct effort put forth to free the passages from the obstruction. If the patient is an adult and the Trendelenburg position can not be obtained immediately Schaefer's[4] method may be employed. This consists principally in placing the patient on his belly and rhythmically compressing the lowest ribs. If enough force is exerted the patient's abdomen may also be forced against the table which will help to expel the air from the lungs. The process is repeated about sixteen times a minute.

In the presence of such an accident, unnecessary haste is to be condemned. Deliberate and accurate movements over a long period of time will accomplish more than hasty and incomplete attempts to contract and expand the chest. One should not give up too soon, for normal respiration has been established after complete cessation of respiration for more than one hour.[1]

If there is any reason to fear that the air is not getting into the lungs from the efforts exerted, a tracheotomy should be unhesitatingly carried out. The head being drawn backwards, so as to put the throat on stretch, the trachea is secured with the left thumb and finger and an incision starting just below the cricoid cartilage is made one and one-half inches long and extending to the depth of the trachea itself at the first stroke of the knife. About three tracheal rings are now severed, this last incision starting from the bottom of the wound and extending upwards towards the chin. A tracheal cannula is then inserted and tied in place by passing the attached tapes around the neck.

Circulatory failure during or after anesthesia may occur suddenly, when it is called *syncope,* or it occurs as a gradual drain on the resisting powers of the organism and appears as shock or hemorrhage. The former condition was formerly more often seen when chloroform was extensively used. It appeared in apparently well and robust as well as in weak and sickly patients. Syncope, or sudden paralysis of the heart due to reflex inhibition[5] of this organ, is produced most often during the early stages of the anesthesia, and the deaths occurring before any anesthetic was given were probably due to this affection alone. It is seen after the handling of the abdominal viscera or manipulation of the main vessels of the neck. The condition has occurred immediately after the patient is suddenly raised from the prone position. In most instances myocardial rather than valvular lesions are found at autopsy. Henderson[6] states that in a large percentage of cases occurring during ether anesthesia the condition is due to unskilful administration, and especially "it is the sequel of light anesthesia." He thinks the effects are produced by a state of "acapnia resulting from excessive pulmonary ventilation during the stage of excitement."

The treatment consists in first stopping the ether, lowering the head, raising the feet, and administering artificial respiration.

If the abdomen is already open direct massage of the heart is carried out. The limbs are bandaged with cotton batting and the head is kept lowered until the patient reacts to the treatment. It may be necessary to give intravenous physiologic saline with a few drops of 1:1000 epinephrin as advised by Sajous.[7]

Venesection is carried out for engorgement of the right heart.

Vomiting is anticipated in very nervous individuals or in those patients who have not received proper preoperative care or lavage on the table. Lavage is indispensable if blood has run into the stomach from a wound in that viscus or anywhere higher up in the digestive tract. It becomes of life-saving importance after any operative procedure for the relief of intestinal obstruction. It occasionally happens after ether anesthesia that the patient vomits before he is fully conscious and is off the table. In such cases the head is lowered to prevent by simple down-hill flow possible suction of the vomitus into the trachea. If this is not practical, the head is twisted well to one side and the body lifted over so that the vomitus will run out of the mouth if the expulsive effort of the patient is not sufficient to force it out. Vomiting at this stage is particularly dangerous because of the possibility of respiratory obstruction and inspiration pneumonia. After reflexes have been reestablished, these dangers no longer exist.

The early vomited material is thin, watery, and chiefly saliva which has been swallowed during the early stages of the anesthesia. Later on some of the mucus, which is generated by the ether, finds its way into the stomach. Bile is added from the intestines in some cases while the operative procedure goes on, while in others blood from a wound high in the digestive tract may be admixed. In such cases the mouth and throat are first freed of all vomited matter before lavage is attempted, while in the other instances the stomach tube is inserted without further delay.

Ordinary tap water is used, since cool water is sufficient to stimulate the partially paralyzed musculature and therefore aids the organ in expelling any undesirable contents. Care is taken that as much fluid returns as is put into the stomach to avoid acute dilatation.

Those cases of shock and hemorrhage which require intravenous medication, hypodermoclysis or supportive enemas while on the table, or immediately thereafter, are considered under appropriate special chapters.

The *bed* into which the patient is deposited was previously made up and warmed with hot-water bottles throughout the period the operation was in progress.

In preparing a bed which will give the quickest and best service to these patients, it may be stated that it is made up in the ordinary way with the sheet covering the mattress, and a sheet, blanket, and counterpane, in order of their mention, over this. In addition, however, two rubber drawsheets are placed next to the mattress, one at the head and the other at the center of the bed. Between the two sheets a single blanket is placed which is covered at its upper portion by an ordinary linen drawsheet. The hot-water bottles are placed beneath this blanket, and the sheet, blanket, and counterpane are rolled back to the side of the bed. As soon as the patient is put to bed, the cover is rolled over him and tucked in at the foot, without loss of time or unnecessary exposure. The hot-water bottles are removed just before the patient is placed into bed, to be used again as often as desired.

A newer method, but one not so well liked by me, is similar to that above, but has a linen drawsheet in place of the single blanket, and the top covers, being already tucked at the foot of the bed, are rolled back and retained in position here. When the patient comes, all that is necessary then is to pull the covers over him. This last method is advocated in some of the latest teachings, as the drawsheet is much easier slipped from under a perspiring and helpless patient than is the blanket. Since the operative case for the first few hours often requires a change of bed linen from perspiration, etc., the drawsheet is probably the best, though for those cases in shock, or those operated late in the afternoon, I would not discard the blanket.

The anesthetist (Fig. 18) should not desert the patient during the transfer from the operating table to the bed or immediately thereafter. The mouth is kept free of mucus, and the jaw pulled forward if necessary to mantain a clear passageway to the larynx, and a basin is kept handy for any emergency. When signs of consciousness return and the pulse and respiration are satisfactory, the patient is safely consigned to the care of the nurse.

The *position of the patient* in bed will depend upon the nature of the operation. In those cases developing considerable mucus during the etherization, and where it is particularly desired to drain the bronchial tree, the ventral position is by far the best I have tried. A pillow is placed under the thorax, which allows the head to rest on a lower plane than the chest, and being turned sideways encourages, not only free drainage of mucus, but also the tongue falling to one side gives free and open passage for the air. The diaphragm is not hampered except in the very obese or the aged. Such do not take kindly to this posture, and these individuals are turned on the side, a bedrest or pillow supporting them in this position. The supine posture, which is so commonly seen, is not desired if for no other reason than that mucus accumulates in the throat and lungs to such an extent that frequently the patient passes through many hard days getting rid of it, to say nothing of hypostases.

In such patients also I have found it extremely helpful to start inhalations of steam even before the individual is fully awake from the anesthetic. Such will materially assist in the early removal of the accumulated secretions and thus prevent in many cases pulmonary complications.

"Ether is eliminated unchanged chiefly by way of the lungs and very slightly through the kidneys and skin.[6,7] With this in view it is particularly important in addition to keeping the air passages free to also see that the air in the room is pure and of even temperature. Usually 68° is found very desirable for all purposes."

The recovery from the anesthetic is commonly accompanied by more or less *delirium* and *restlessness.* In some cases the patient is excitable and noisy, very talkative and thrashes about aimlessly and often his movements are most violent. He should not be restrained at first, but attempts should be made to attract his attention in an effort to persuade him to be quiet. In the meantime the parts of his body which have become exposed to the cold as a result of his movements are covered, and special precaution taken to prevent unnecessary chilling. In the majority of cases even after the initial delirium has passed and the patient is conscious he will exhibit considerable restlessness. By careful observation one is frequently able to determine the cause and at once correct it to the patient's satisfaction. It may be due to concern as to the outcome of the operation or to mental distress previous to the etherization. *The reassurance of a kind, attentive nurse will do more to alleviate the restlessness of a patient who is not in pain than will most drugs.* The changing of the position or the moving of a limb, acceding to the wishes of the patient concerning his comfort as to bed clothes, loosening a tight bandage, washing his mouth, placing a pillow under his back, readjusting

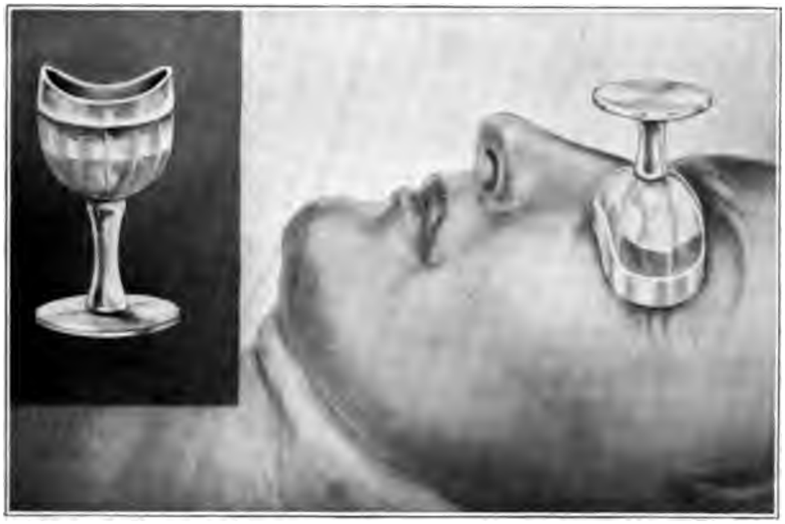

Fig. 18.—A convenient method of washing an eye which has been irritated during anesthesia.

those under his shoulders or head, and many other measures carried out even though many are to satisfy childish wishes, are the endeavors which satisfy his desire for comfort.

If, in spite of every effort to comfort him, the patient becomes worse, he is restrained by assistants just enough to prevent him from becoming chilled from exposure, from injuring himself or others, or doing any damage to his surroundings. In some instances (when short of help) it becomes necessary to put a restraining sheet over his body, but at no time should the minor movements of his limbs be restricted, as this particularly makes the patient more untractable. In these cases it becomes necessary to give morphine until quiet is secured. After the effects of this drug wear off, as a general rule, patients wake up docile and in their right senses.

Some of our modern operators do not give a preanesthetic drug, reserving such medication until this period when small doses are continued over short periods of time until the patient is asleep and has passed a comfortable night.

Whether medication is utilized for the condition or not it is very important to keep the patient undisturbed by noise; the window blinds are to be pulled down, the room darkened, and the patient not allowed to talk, but told to go to sleep. Visiting in this early period is prohibited, and so long as the general condition is satisfactory the patient is not disturbed under any circumstances.

Restlessness due to causes other than the anesthesia, such as pain, hemorrhage, shock, etc., is treated under the respective headings. I believe most of the restlessness which in earlier times could not be explained by something in the patient's condition was the result of acid intoxication and should have been treated by earlier feeding, morphine, alkalies, much water, etc. However, in every case this possibility is considered, and in the proctoclysis which is started as soon as the patient comes from the operating room in the work of some surgeons, a five per cent glucose solution in plain tap water is administered. In addition a teaspoonful of sodium bicarbonate is placed in each pint of proctoclysis water for the first twenty-four hours.

Sweating is a common occurrence in patients just after operation. Ether in itself dilates the superficial capillaries and the resulting perspiration all over the body during a short anesthesia in healthy individuals does not cause alarm. However, extensive sweating throughout and after a long and tedious operation is noted with concern even in the most rugged as it is weakening to the patient and often a definite sign of shock, hemorrhage, etc. In the latter instances it is more or less cold and clammy and has an altogether different meaning from the usual perspiration. In any case where the patient is allowed to sweat profusely the danger of chilling with its subsequent effects is increased and should not be allowed over any length of time, even in the operating room, much less after he returns to bed. In such patients measures are taken to relieve the condition first by avoiding too much cover after the body has been wiped dry and in some instances atropine hypodermically is employed with good results. In every case the general condition of the patient must be considered and treatment carried out to eliminate, if possible, the existing difficulty, such as hemorrhage, shock, etc.

Sweating is often prolonged and intensified by the *injudicious use of too many bed covers*, especially in hot weather. A nurse frequently follows out some routine when common sense dictates that she be guided by the amount of moisture on the patient's skin. It has not been uncommon in my experience to find a patient who is only half awake vainly endeavoring to free himself from perspiration-soaked linen while his attendant readjusts the blankets with misdirected zeal.

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CHAPTER VI

EARLIEST SUBJECTIVE MANIFESTATIONS

By O. F. McKittrick, St. Louis, Mo.

Pain.—One of the first complaints made by the postoperative patient on returning to consciousness is *pain.* This if due to the actual operative procedure should be at once relieved. William J. Mayo taught us long ago to give morphine during the first twenty-four hours for the pain which *we* make; viz., by cutting, retracting, suturing, etc. The discomfort caused by such procedures is relieved best by this drug and it is given by us if there be no contraindications for its use, regardless of the amount until full relief is experienced or its physiologic effects obtained. The respiration should be watched carefully in every case and if it becomes less than 12 per minute the drug is discontinued at once. Usually one dose of gr. 1/4 hypodermically is sufficient. It should be borne in mind, however, that one must first get some idea as to the location and nature of the pain since it too often happens that some local cause irrespective of the operation is to be found. A pin from an abdominal binder may have caught the skin or a bandage may be too tight. Strong chemicals used about the patient during the operation may be an exciting cause. Murphy[1] states that the common household flea has caused considerable distress in these cases.

Abdominal operations give more pain as a rule than operations elsewhere over the body. In addition to the actual trauma produced, the excursions of the diaphragm and the abdominal movements caused by coughing, vomiting, etc., materially aggravate the condition. Often after these operations it is particularly useful to give the morphine before the patient is fully conscious and he will then pass from the sleep due to the anesthetic into that produced by morphine, and in many cases escape the frequent nausea and vomiting and general distress of the immediate effects of the anesthesia.

In neurotic patients especially I have carried this out with most excellent success. In this class of cases also it is commonly noted that the most excruciating pain is often felt, and it seems to matter very little whether the operation was an extensive one or not. However, the extent of the operation is never an indication of the degree of pain even in the most phlegmatic, neither can the amount of anodyne to be employed be so determined.

Finney[2] states "that there is a definite psychology of pain difficult to understand, perhaps, but nevertheless well recognized by every intelligent observer. Some one has said that pain is the resultant of two factors, the lesion and the patient, and in order to arrive at an intelligent appreciation of its true significance both must be thoroughly understood."

"The mental state of the sufferer varies greatly in different individuals and at different times. Frequently he will unintentionally deceive his physician by his inability accurately to describe his sensations, especially is this true of pain, which is purely subjective. Again he may do so intentionally by false statements as to its character, location and intensity. In some, pain brings out the heroic, often to a very unexpected degree. In others, it develops the hitherto unsuspected 'yellow streak.' It does not always follow that because a patient bears what appears to be a great amount of pain with remarkable patience, that that individual is more deserving of credit or shows greater self-control than the one who does not; for it is a well-established fact that pain is not felt to the same degree by all individuals alike, some are much more tolerant of it than others."

Pain occurring after operations upon bones, joints, etc., and where it becomes necessary to apply plaster casts while the patient is under anesthesia should be given most attentive care. These cases are always allowed to become fully conscious and the cast then inspected to see that no unnecessary pressure is exerted anywhere. The circulation and sensation are carefully studied and though the patient complains of no pain, any coldness, blueness, or unexplained swelling or numbness of the parts are at once corrected by cutting "windows" in the cast or even cutting it throughout its whole length, and after relieving the pressure, the severed portions are held together with adhesive.

Pain produced by splints of any kind is not to be neglected a single moment. They are difficult to apply to an unconscious patient and it is to be expected that complaint will often be made and that some readjustment will be necessary.

A case is brought to mind in which a resection of the jaw was performed for carcinoma. The teeth on the sound side were wired so as to keep the parts as nearly as possible at rest. The patient, on awakening from the anesthetic complained of pain in his neck and face and the usual morphine was ordered without particular attention being given the inside of the mouth. The patient passed a miserable night though a second dose of morphine was administered. During the next day he still complained of the neck and face. Examination revealed that the wire had broken and that one sharp end had prodded the gums until a severe wound had been inflicted. Removal of the wire splint gave instant relief.

Other instances may be mentioned in which too tightly applied bandages caused swelling of the parts; the limitation of an improperly applied bandage, particularly one made of crinolin or plaster of Paris has caused such pressure with pain as to produce extensive excoriation of the skin. How often do those patients on whom the perineal straps were applied too tightly present the next morning a denuded area of epidermis the entire width and length of the strap. On the other hand too loosely applied bandages will permit the dressings to slip about over the wound and cause unnecessary pain and exposure to infection. Adequate inspection will usually decide the point in question and the proper course to be taken.

Pain is anticipated in amputation by placing the stump with its dressing in a pillow splint. The muscular spasm sometimes experienced in these cases is severe and such simple measures will prevent this difficulty. However, if any pain does occur, readjustment of the splint and massage of the muscles will usually give instant relief.

Pain about the operative wound during the first twenty-four hours does not compel inspection except in particular instances where it may become necessary to shorten hard rubber drains which are found to be too long or to lessen the pressure of the dressing over them. The ends of silk worm sutures may be irritating the wound or occasionally the incision has been too tightly closed.

Pain occurring after twenty-four hours is usually due to causes *other than operation* and they must be sought for and the proper specific treatment instituted. The most common cause is abdominal distention by gas, and measures are promptly instituted for its relief. However, acute cystitis is another frequent cause in gynecologic operations, while various acute inflammations in other parts of the body play no little part in the late pain which some patients suffer. Treatment locally for each individual complaint is instituted, but morphine is withheld except in cases urgently demanding its use. Commonly the cystitis will disappear with 20 to 25 grains sodium citrate every four hours together with boric acid irrigations once or twice a day, and the inflammations elsewhere are relieved by the application of the ice bag or upon putting the parts at rest by means of adhesive, etc.

The time of day seems to influence the patient to the end that discomfort is more marked at night. Whether it is due to the fact that at this period the patient has less to attract his attention so that he can therefore center upon himself, or because his senses are more acute at this time, it is difficult to say. Certain complicating lesions we know, are more painful at night, particularly those affecting bone or due to syphilis. It is well at any rate to bear this fact in mind and to see that such patients are cared for at this time.

Any sudden changes in the weather, especially from good to bad, will often elicit aches and pains which can not be otherwise accounted for. Pain in the female is much better borne than that in the male. It has been said that response to painful stimulation of all kinds is much more sluggish in them than in the opposite sex. The matter deserves particular attention and it is naturally to be expected that our male brothers will be more or less sensitive on this subject.

The second postoperative day should require less anodynes than the first. Rarely is it necessary in this period to give morphine at all except in very small doses and most commonly codeine with aspirin will suffice for any ordinary discomfort the patient has. Aspirin is given in 5- to 10-grain doses with ½ to 1 grain of codeine. Suppositories of 1 to 2 grains of opium are very efficacious in pain from operative procedures about the pelvis. These are not needed long and soon the simpler and decidedly less harmful drugs will allay any pain or discomfort that may arise.

Thirst.—Thirst, which is of common occurrence after a general anesthetic, can to a great extent be prevented by allowing the patient to drink liberal quantities of water up to an hour before the operation, when I insist on one glassful being taken. This matter must have careful attention, since many unthinking nurses still send all patients to the operating room dehydrated. It is particularly unfortunate that such should be the case since the cause of the thirst in the first place is in great part due to loss of the body fluid through preoperative purgation or to increased urination in some cases from sheer nervousness; while the sweating, increased mucus secretion, or loss of blood during the operation adds to the dehydration. Finally, the postoperative vomiting with the attendant after-effects of ether together with those of morphine and atropine which inhibit the mucus secretion and thereby increase the dryness of the oral mucous membranes, increases the torture from prolonged thirst. Formerly all fluids per mouth were prohibited for the first twenty-four hours, it being considered that such measures would stimulate postoperative nausea and vomiting. Happily such an idea has been superseded by the more sane opinion that the demands of nature should be granted. Consequently, just as soon as the patient is awake his complaint of thirst is immediately met by giving sips of hot water for the first few hours. The taste of the ether and the sticky mucus and saliva are cleared out of the mouth by allowing the patient to rinse it with equal parts of rose water and glycerin or to this may be added a little lemon juice. If he is unable to do this himself the nurse can swab his mouth out with equal parts of glycerin and 4 per cent boric acid solution. Sometimes a little weak tea is better than the plain water in allaying the immediate effects of the condition. Very soon the hot water can be replaced by cool water, but this given in moderate quantities. The *continued* use of water in very small amounts is not an especially good practice, as nausea and vomiting are invited and the irritating mucus in the stomach secreted during the operation is not washed out. Fairly liberal quantities of water, on the other hand, do not require so often disturbing the patient, more fluid is absorbed and if the patient vomits the quicker will the gastric mucous membrane be cleansed and the normal tone of the musculature again restored. Ice water is severely condemned as a drink, neither should it be used to wash out the mouth. In order to facilitate the taking of fluids, a bent glass tube is placed in the glass (Fig. 19) and the liquid sucked into the mouth without it being necessary to raise the patient.

In every case even though the preoperative preventive measures to relieve thirst have been carried out, this phase of the treatment must be considered if there has been a marked loss of fluids during the operation; physiologic salt solution or distilled plain sterile water should be poured into the abdominal cavity. If this is not practical an enema of plain water or hypodermoclysis should be administered on the table.

As a routine before the patient is awake, slow proctoclysis of tap water is given by many alone or in conjunction with glucose sufficient to make a 5 per cent solution, and to this also at times is added sodium bicarbonate of the same strength. In those urgently requiring larger amounts of water quickly, hypodermoclysis or even intravenous injections are employed. Unfortunately, however, the psychology of thirst definitely indicates the *swallowing* of fluid.

Nausea and Vomiting.—Nausea, and often retching and vomiting, are particularly common after-effects of a general anesthetic. Usually the vomiting from ether takes place early during the period in which the patient is recovering as noted above, and frequently it is of such short duration that he is unconscious of its presence and does not remember it afterwards. However, not all patients are destined to such good fortune, and it is so common to see this complication for hours and even days continuously or intermittently that further discussion and attention must be given it.

The causes for such a condition can often be traced to the method of ether administration, trauma produced by the surgeon, or unnecessary handling of the patient immediately after the anesthetic. Halperin[3] states "that there is more vomiting from five minutes of an irregular anesthesia than from one hour of an even one. Excessive stimulation by hypodermic injections during anesthesia may be a contributing cause also." A protracted anesthesia and a long fatiguing operation during which extensive handling of the stomach and intestines has taken place certainly adds to the frequency of the disturbance. Operations upon highly nervous patients or upon those with improperly prepared gastrointestinal tracts are commonly followed by protracted vomiting. Patients starved to excess without proper food compensation before operation develop an early acidosis (if this is not already present) and rarely fail to exhibit severe nausea and vomiting as a result of this complication alone.

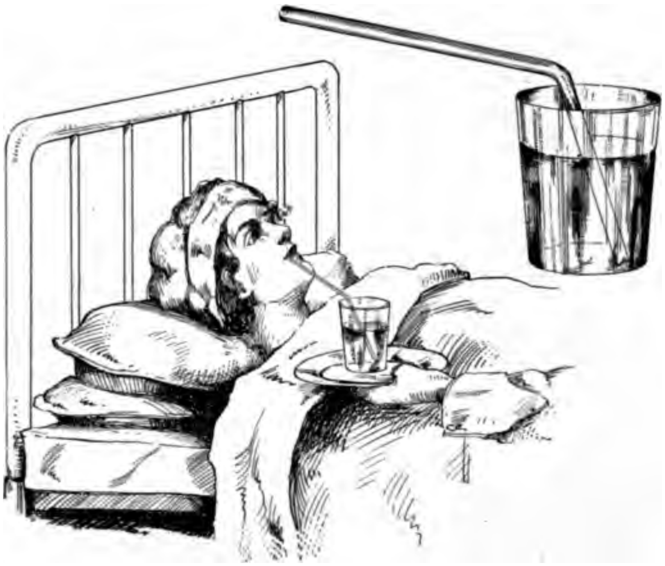

Fig. 19.—A convenient scheme for the early administration of fluids.

After the anesthetic any body movement tends to increase vomiting, and this should be borne in mind during the period of immediate recovery when the sufferer should be kept absolutely quiet in a dark room and prevented from talking.

Nausea and vomiting may be caused by irritation of any peripheral branch of the vagus nerve. Buxton says that when it arises "from cerebral or cerebellar conditions it may be due to the head having been kept at too low a level. Unless there is obvious ischemia of the brain, prolonged depression of the head especially in plethoric persons will tend to produce postanesthetic sickness."

Nausea and vomiting may be the result of renal complications such as uremia or the forerunner of some infectious disease such as pneumonia, etc., or may be manifestations of chronic alcoholism, nervous dyspepsia or an actual lesion in the gastrointestinal tract. Beginning peritonitis or intestinal obstruction may be an inciting cause. Reflex vomiting from pressure of drains, packs, headache, etc., can not be too lightly passed over.

Treatment first consists, provided there be no specific contraindication, in allowing a liberal quantity of water per mouth. This, as a rule, will be immediately returned, and with it the local irritating foreign substance, whether it be food taken before the anesthesia, or mucus, saliva, blood, etc., which have entered the stomach during the etherization, and not been returned during the initial vomiting on the table or during unconsciousness.

The giving of *sufficient* water by mouth in these cases can not be too thoroughly impressed upon the timid person in charge of such a patient. One who has gone through it knows the torture of continuing to retch after the stomach has been emptied. It is alleviated only by allowing one to drink a glassful of warm or not too cool water. This is repeated as often as the patient vomits, care being taken, of course, that the stomach returns as much as it gets, since otherwise an acute dilatation may be caused.

I learned a never-to-be-forgotten lesson in the days when no patient was given water for the first twenty-four hours. A woman who suffered particularly from nausea and retching managed. to get her hands on a flower pot, which her nurse had just filled with water, and drank the turbid fluid with evident relief of symptoms after vomiting once more. This suggested a self-evident therapeutic procedure which has been followed ever since with highly gratifying results.

Luke[4] reports an instance where a young woman drank the contents of a rubber hot-water bottle "immediately after an ovariotomy, without any apparent discomfort or harm," and others have reported similar occurrences, a thing which has done more to advance the present humane treatment of these patients than any other one thing.

In instances where it is not desirable to use the stomach tube and in those whose stomachs have been reasonably well washed by the procedure described above, medication may be resorted to, although not much is accomplished in this way. An ice bag or hot-water bag is placed over the epigastrium. In very nervous individuals a good placebo is the old-time mustard plaster placed over the pit of the stomach. Sodium bicarbonate in 20-grain doses in a little warm water or $\frac{1}{12}$ to $\frac{1}{8}$ gr. cocaine hydrochloride[5] may prove of value. A little champagne or ginger ale at times gives relief. Ferguson[6] uses liquid petrolatum which protects the mucous membrane of the stomach against any possible continued excretion of the ether by this viscus. This is considered by him better than olive oil which has been used in such cases, since the latter saponifies and is then absorbed, thus causing a re-excretion of the ether with its attendant effects. Olive oil, however, raises the resistance of the patient by stimulating phagocytosis according to this same author and it may be used per rectum in 6-ounce doses to good advantage.

By far the best, and, in fact, the only reliable treatment for this condition, is gastric lavage. Its use on the operating table has already been mentioned. Its continued use after the patient is awake so long as there is any nausea or vomiting in those permitting its employment, can not be too greatly extolled. It is self-evident that some irritating substance must be present in the organ if the desired result is to be obtained. Often a carrying out of the procedure not only relieves the actual distress of the symptom itself, but also puts an end to the anxiety and restlessness which so commonly are manifested by these sufferers. Especially is this true in those instances where the stomach has a tendency to dilate and be inactive. In the cases in which acute dilatation occurs unfortunately this symptom is less marked, the general appearance of the patient, the pulse rate, pain in this region, hiccough, and other less common symptoms being more in evidence. It is needless to say that gastric lavage under such circumstances is most urgently needed. In addition a hypodermic of pituitrin (5 to 15 minims) is advisable.

In carrying out this procedure one will always experience more or less difficulty with the patient. The fear of the tube and the discomforts it entails, especially in individuals who are unaccustomed to its use, are not to be treated with little concern. A knowledge of the condition of the heart and lungs is very necessary, and most of all, the confidence of the patient must be gained. The procedure should be explained and the results to be obtained discussed with the patient, and his cooperation secured before any attempt is made to introduce the tube.

He is then raised slightly upon pillows, and if it is convenient, turned on his side. A rubber sheet is placed over the bed and around his neck, the sheet extending into a basin on the floor. A towel is kept handy for the operator and a small basin for the patient to spit into. In some very nervous individuals it is advisable to spray the pharynx with a 20 per cent solution of cocaine in order to allay the gagging during the passage of the tube. After one minute the cocaine is spit out and the spraying repeated in five minutes, as advised by Ochsner,[7] permitting the patient to swallow a little of the saliva which will, to a certain extent, anesthetize the esophagus. Poisoning by the medicine is prevented by the free expulsion of the saliva which accumulates in the mouth during the administration.

In the majority of cases such measures are unnecessary, and, as a rule, the tube is inserted without any such elaborate preparation.

The head of the patient is grasped by the operator, which maneuver not only supports it, but allows a more efficient manipulation of the tube. This instrument is now taken from a basin of ice where it was placed at the beginning of the procedure and the patient is asked to breathe through the nose and to give undivided attention to the admonitions of the operator who will ever insist that he keep breathing through his nose. The tip of the tube is held by the operator's hand which has just been thoroughly washed (some use rubber gloves), and the other end held down by an assistant near the basin on the floor. The tube is now gently inserted (without lubrication—some use glycerin) straight back into the pharynx and then down the esophagus, the patient in the meantime being asked to swallow. Once in this organ the tube is pushed rapidly downwards until the white line on it is reached (depending on the length of the patient, of course). During the while the patient is being reassured by the operator and continually reminded that all he has to do is to breathe. The necessity of being patient and kind at this time even though the individual suddenly pulls out the tube is to be impressed upon the operator, since once the patient *learns how* to take the tube, no further difficulty need be experienced, and the impression made during the first insertion will usually be foremost when the procedure becomes necessary again during the course of the treatment. The tube is now brought to the side of the mouth and held in position while an assistant fills the funnel of the tube with cool hydrant water and starts the siphonage.

If there is any difficulty in getting the water to flow, the tube is rotated and it is either pushed further in or pulled out. In some cases a Politzer bulb has been used, or an attached bulb is employed in sucking out the air, which maneuver will nearly always start the flow; this tube integral with bulb, however, is not very practical and is not extensively used by me.

As much fluid should be returned as is poured into the stomach; the flow is frequently started and kept up by allowing a funnelful to flow in, but before it becomes entirely empty lower it and then pour it full again, the maneuver being repeated until the fluid returns clear. It will be noted that the patient himself frequently holds the tube in place better than does any one else. With proper training and care with patients they very soon learn to help themselves and become valuable aids to the operator. In such instances one person alone can wash any stomach.

The stomach should be washed as often as the nausea or vomiting returns, each time washing until the fluid returns clear if it takes considerable water to accomplish this end, so long as the patient is not too exhausted. The tip of the tube should have more than one opening which will often prevent blockage either by contact with the stomach wall or by mucus.

Kanavel[8] employs a special tube by means of which continuous gastric lavage can be instituted in the most intractable cases. I heartily concur in such a measure, as the strain of having the tube inserted is done away with. I have employed this method in a few cases, utilizing the ordinary stomach tube, but after a time even the most phlegmatic patient tires and begs to have the tube removed. Kanavel's[8] tube is smaller and more suited for the purpose and should be tried in every intractable case, especially where the insertion of the tube is not an easy procedure.

It has long been taught that anesthetics should not be given except in the presence of a third person. The reason for such teaching is supported by the symptoms exhibited at times in the postoperative patient.

Dreams.—It is common knowledge that dreams occasionally occur during the anesthesia which are honestly believed long after the patient has recovered. This affords a chance for blackmail or other unpleasant developments, hence measures taken to thwart such possibilities are always carried out by the wide-awake operator. The *delusions* take the form, particularly in neurotic women, of an idea that a sexual advantage has been taken of them while unconscious. It should be added, however, that not only do these nervous women make such charges at times, but that the most refined phlegmatic women have been guilty of the same statements.

Mental Aberration.—In the aged and in individuals with nervous instability the shock of an operation can be to blame for more or less mental aberration which may suddenly develop during the early period of recovery. It has been said that this is due further to the use of drugs during the operation or in the early after-care. Certainly those mental disturbances occurring after eye operations and which are mostly hallucinatory in nature are due to this cause alone. Sajous[5] states that "excluding the cases due to shock, nervous strain, exhaustion, and drug intoxication, which generally appear within the first twenty-four hours, it is probable that the majority, if not all, of the cases of postoperative insanity coming on within the first week are septic in origin." That it should occur at all is deplorable, but when it does, the shrewd surgeon will have been fortified against the consequences, and will be left unhampered to combat the new condition as best he knows how. For suggestions as to treatment, the reader is referred to the chapter on Postoperative Psychoses.

Complications Arising after Local Anesthesia.—The complications arising after local anesthesia are not as a rule nearly so many or so frequent as those occurring after general anesthesia. The nature of the complication and the extent of its severity depend upon the operation performed. Since practically every operative procedure which is carried out under general, can also be done under local, both are entitled to the same complications. However, the latter apparently entails few of the horrors of the former, and it is generally conceded that the postoperative discomforts and risks are materially less, particularly the dangers of pulmonary disorders.

The after-care for the ordinary minor operations need not be mentioned, since it resolves itself practically into the care of the wound alone. After major operations the same systematic care is exercised as in those patients who have been given a general anesthetic. With these patients who have had a local anesthesia sometimes the first complaint is *nausea* which often develops into actual vomiting. This is undoubtedly due, in many instances to the morphine so generally given before operations. The same efforts put forth to relieve this condition after a general anesthetic are also carried out here. It is here not so necessary to exhibit much care in giving fluids, since those are nearly always taken with impunity, even when the stomach is temporarily upset by the preceding operative maneuvers a few glasses of cool water will not only clear the mucous membrane thoroughly of any excessive mucus and gastric juice which had been secreted, but also will assist in giving added tone to the musculature which has relaxed during the period of mental strain and distress while the patient was undergoing the actual operation. The nausea usually does not last long and under the same handling that is afforded the general anesthetic patients it will clear up in a very short time.

Pain is not experienced at all until the effects of the anesthetic wear off, when it becomes excruciating at times. In practically every case more or less pain is experienced in the wound, and measures are taken to relieve it as is done following general anesthesias. After the first twenty-four hours it becomes less and less, morphine being rarely necessary after this period. The edema and induration about the wound last longer because of the foreign material injected at the operation, and for this reason most attention is paid to the wound itself. In order to alleviate this as much as possible, I employ pure glycerin directly over the wound after the first twenty-four hours, the dressings being kept moist with this chemical for several days, or at least until the swelling and induration have been decreased to a minimum. Glycerin is not only a hydroscopic agent, but also is slightly antiseptic and such wounds kept bathed in it seldom develop in my experience the "fiery swollen appearance" seen occasionally after local anesthesia. It should also be cautioned that this treatment extending over too long periods of time will cause a papulovesicular eruption around the wound edges which predisposes to infection, and just as soon as this occurs the glycerin must be discontinued regardless of the condition of the deep tissues in close proximity of the wound.

Immediately after the operation if it has been an extensive one, the patient will express a sigh of relief and rejoice at the prospect of going back to bed. Once here, it will be only too evident that he is *tired out* from the strain, which practically all patients undergo, and will welcome sleep.

It may be necessary to massage his strained and bruised muscles or at least give an alcohol rub in addition to making the patient comfortable by placing his pillows properly and putting hot-water bottles around him (always bearing in mind the possibility of burning him). When his discomforts are relieved, the room is darkened, all visitors excluded, and the patient encouraged to relax, refrain from talking, and attempt to lose himself in sleep. If the *exhaustion* has not been too great, sleep will come shortly if precautions have been taken to have the bed and room prepared as is ordinarily done for patients who take a general anesthetic. The rest which he thus secures will do more to alleviate the suffering of the worn-out body and mind than will any drug. Morphine in small doses is given to prevent possible pain in the wound disturbing him during this period of slumber. As a usual thing these patients will go to sleep without any medication, but occasionally one is not so favored. It is a good rule to give with the proctoclysis 30 to 60 grains sodium bromide, to every nervous patient, and to this may be added at times 25 to 30 grains chloral hydrate. An ice bag over the fast and palpitating heart in neurotic patients will do much to quiet this organ and allow rest and perfect recuperation.

Light nourishment in any form suggested by the patients is to be allowed at a very early period. Its importance is second to that of sleep only as a means of quieting and restoring the individual who has just experienced an operation under local anesthesia.

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CHAPTER VII

LATER SUBJECTIVE SYMPTOMS

By Willard Bartlett, St. Louis, Mo.

The patient has recovered full consciousness and though his "earliest subjective symptoms" may still be present, he now begins to manifest certain conditions which are directly attributable to the manipulation to which he was subjected while still on the operating table or during the period of returning consciousness. They cause at times no little irritation and annoyance to the patient. Such accidents happen in the hands of the most careful surgeon or of the best surgical teams, and apparently can not always be avoided, which fact makes their occurrence none the less deplorable. The surgeon's embarrassment in many instances is intensified by the prospect of a damage suit, a phase of the matter which should not be too lightly passed over by him.

Ether Conjunctivitis.—Ether conjunctivitis is rapidly becoming a very uncommon accident, a fact which is indeed welcome to both the profession and the laity alike. This complication has, in my experience, always produced more suffering than has the wound coexistent with it. This is particularly true in all cases where the eyes were not irrigated immediately upon the entrance of the ether. I have most frequently observed it when the eyes were covered with rubber, gutta percha or other similar impervious materials. A drop of ether or even ether vapor which once gets under such a covering is held *confined* there and much damage done in consequence.

The results of this accident are usually complained of next day when the patient notes a smarting and burning in the eye affected. On examination one will find an active hyperemia of the conjunctiva, the vessels being prominent and the palpebral conjunctiva being more vascular than usual. Other portions of the conjunctiva become involved later. The lids become swollen and in the most severe cases the conjunctival sac may fill with pus. Under proper treatment the condition does not extend beyond a simple catarrhal inflammation and its duration is short. Cases with more extensive involvement should at once be turned over to an oculist, as the danger of corneal ulcer is imminent. Careful examination of the eyes in patients suffering from ether conjunctivitis can not be too strongly insisted

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upon. I had a patient of this kind threaten malpractice suit at a remote period, claiming that my carelessness had resulted in a corneal ulcer. To be sure a scar could be seen and the thing was not disposed of until, by mere good fortune, I happened onto the oculist who had treated her corneal ulcer previous to our operation.

The treatment is first and always preventive. All trained anesthetists have individual methods of protecting the eyes during the etherization. Personally I have not had one complaint after many thousand anesthesias in which the Ferguson mask has been used and the eyes of the patient *left uncovered.*

If there is any reason to believe that ether has come in contact with the eye, I would advise, as Crandon[1] already has before me, that the eye be irrigated at once with a little warm water, physiologic salt, or 2 per cent boric acid solution. I have on more than one occasion seen a drop of ether fall directly into the eye, but never heard a later complaint where it was followed in a few seconds by irrigation with any of the above liquids or a drop of sterile olive oil. This lubricant, particularly, should be kept in the operating room.

When the condition occurs in spite of the measure suggested above, the eyes are irrigated twice a day with 2 per cent boric acid solution and the eyes protected from the light glare, either by smoked glasses, eye shields or keeping the window shades down.

During the early stages one may employ with advantage Posey's[2] technic which is carried out as follows: "Several pads of gauze of three or four thicknesses, about the size of a silver dollar, are laid on a block of ice. The ice should be suspended in a receptacle with perforations in its bottom, which will permit the water and any secretion from the compress to drain off into a jar beneath it. An ordinary kitchen colander and washbasin will answer very well for this apparatus. One of the pads is taken from the ice as soon as it has been saturated and is applied to the closed lids, removed in a few moments and a fresh one substituted for it. Compresses of absorbent cotton which have been soaked in ice water may also be employed. They should be squeezed out sufficiently to prevent any of the water trickling over the patient's face and neck." The compresses should not be continued over twenty-four hours, and applied every other hour. The danger is devitalization from the cold which may result in corneal ulcer.

Dry Mouth.—The association of dry mouth with general thirst on awakening from an anesthesia is so intimate that the condition has already been discussed under this head. There is, however, another phase to this subject which requires further attention than has hitherto been given to it. I refer to the management of the patient while still under the influence of the anesthetic or during the sleep resulting from the preanesthetic drug. It is my observation that an otherwise attentive and capable nurse will allow an unconscious patient to breathe with the mouth wide open and not make an attempt to prevent the mucosa becoming as dry as the skin outside. This can be prevented by the simple maneuver of keeping the orifice covered by a few layers of loose-mesh gauze which are frequently moistened in a solution of glycerin and water of equal parts.

Dry mouth occurring later on in the convalescence and not caused by a general loss of body fluids during the operative procedure or an insufficient intake after the operation may be caused by disease of the salivary glands or of the ducts, or of both. It may also occur as a local result of the operation itself. A recent case illustrates this point quite well. I removed a carcinoma from the floor of an elderly gentleman's mouth and in the course of the operation destroyed all the salivary ducts in this region. By the time healing was complete, his complaint of dry mouth was most insistent. Chewing gum, slippery elm, and other remedies were tried in vain until I hit upon the idea of a film of mineral oil (petrolatum liquidum) as a substitute for saliva. The result was astonishingly good; so much so that the patient when seen a year later extracted a tiny bottle from his pocket with the remark, "My mouth never gets dry as long as I carry this and take a few drops of oil every hour or two."

The treatment of this condition in addition to that suggested above consists first in finding the cause. This is usually the result of insufficient fluids in the body and is remedied by increasing the intake as already described. In the meantime the mouth is frequently rinsed with cool water, or a cool sponge wet with this medium is retained. Another may be applied over the lips. If the inside of the mouth becomes stagnant due to improper cleanliness on the part of the patient from any cause, it is cleaned frequently by the nurse with a swab of gauze saturated in 4 per cent boric acid solution. In addition, once or twice daily olive or mineral oil may be applied in the same manner.

Painful Tongue.—The tongue may become affected independent of a dry mouth, and in fact most often gives trouble in those cases where some manipulation of this organ was necessary during the course of the operation. It is necessary as a matter of course that the tongue be held forward during the course of many general anesthesias to facilitate respiration. If this be done with a crushing forceps, so much pain and swelling are caused for a few days that the patient may suffer more in consequence of such maltreatment than he does from the surgical wound itself. Considerable pain will be produced even though such clamps are not used but instead instruments especially devised for this purpose such as the Carmalt forceps. The painful after-effects should be considered at the time of the manipulation, and these so far as possible mitigated by a more refined and humane manner of handling this sensitive structure.

The anesthetist who grasps the tongue with a gauze strip held between the thumb and forefinger probably does not damage it at all. There are many case in which, however, such gentle measures do not suffice, here I recommend the transverse insertion near the tip, of a slender thread carried by a fine needle. This is far better than the tenaculum used by some anesthetists, which is in turn vastly to be preferred to a crushing instrument.

The *treatment* is simply palliative. The mouth and teeth are kept clean with some antiseptic mouth wash such as liquor antisepticus alkolinus, 4 per cent boric acid or Dobell's solution (diluted one-half its strength). Potassium chlorate, saturated solution, or potassium permanganate 1:4000 may be employed if the condition does not speedily clear up. It may be necessary to hold ice on the swollen tongue for the first day or so. I have never seen this necessary as the warm mouth washes were sufficient in every case. Silver nitrate in 10 per cent to 20 per cent solution may be used directly on the lesion if it is slow in healing and one of the stronger mouth washes employed several times a day.

For any injury of the tongue during convalescence the treatment is the same as the above unless it is so extensive that surgical interference is necessary to control hemorrhage. One patient came under my observation who accidentally fell on the tenth postoperative day, while attempting to walk to the bathroom; she struck her chin and nearly bit her tongue in two. Several stitches were taken without an anesthetic, and a potassium chlorate mouth wash used three times a day for six days, when the wound had healed. A warm boric acid wash was used for a week longer, during which time all soreness and other inconvenience completely disappeared.

In the presence of this complication it is best to give the least irritating foods, particularly those soft and warm and free from high seasoning. In some severe cases, as in the one mentioned, the food may be given in liquid form through the nose for a few days.

Sore Jaw.—A sore jaw is one of the disagreeable experiences which sometimes go together to make up a never-to-be-forgotten picture, when surgical treatment has not been judiciously managed. It is now and then necessary during, as well as after, a difficult anesthesia, to hold the jaw forward in order that the muscles running from the symphysis to the hyoid bone may hold the pharynx open. This is commonly done with the fingers hooked around the ascending ramus just above the angle, and very slight damage is done provided the pressure is not too long maintained, unless the tips of the fingers are carelessly allowed to slip too far around the bone and infringe upon the deep structures of the neck.

Under such circumstances an effect is produced very similar to that for which the jiujitsu wrestler strives, and the patient is caused undue suffering in consequence. The procedure can be varied from time to time with advantage for the patient as well as for the anesthetist by hooking the index finger over the incisor teeth and the thumb of the same hand under the symphysis and pulling instead of pushing the mandible forward.

The treatment in addition to the preventive measure stated above is palliative. The condition usually disappears in a day or so; it is, however, not always best to await a favorable outcome, but to institute some measure of relief at once. Probably massage is the best remedy at our command, this performed for twenty minutes twice a day will help clear up the worst cases of this nature. Various counterirritants, such as turpentine or some liniment whose principal ingredient is chloroform or ammonia, will also prove efficient in the patient's mind at least. The external application of heat may be tried on those cases where no application of drugs is made.

Sore Throat.—Sore throat is particularly likely to follow any operation in which there has been manipulation of the trachea, larynx, etc. We note it most commonly after thyroidectomy. It may be prevented in many patients by placing them in bed flat on the face, with a pillow under the chest immediately after the operation and leaving them in this posture for several hours or until it becomes intolerable. A moment's reflection will convince any one that downhill drainage of the respiratory passages is secured in this manner; in fact a surprising amount of mucus and saliva runs out, which in any other position would tend to fill up the bronchial tree, and require, in my experience, some days to be coughed up.

Nothing else has compared in my hands with the inhalation of steam for the *relief* of surgical sore throat. Many other remedies have been proposed, and tried by us, only to be discarded. Some of our patients seem to gain a measure of relief from holding ice in the mouth, and others from gargling a mild alkaline solution. The steam is, however, practically unfailing in its effect.

Painful Respiration.—Painful respiration is a serious matter because it often influences the patient to protect himself by limiting the respiratory excursion, with imperfect lung ventilation and pneumonia as a consequence. This train of undesirable events is prone to follow the making of wounds low on the chest wall or high on the abdominal wall; especially is this true if such wounds are unduly tender in consequence of inflammatory changes. It may also be caused by violent use of the diaphragm, as in vomiting, or the chest wall may have become injured as a result of artificial respiration or careless handling, while removing the patient to bed, etc. The pressure of extensive gauze packing, or of clamps left hanging on the tissues near the diaphragm constitutes an added risk.

Little is to be feared from an intelligent patient who will sit up in bed and inspire deeply a few times every hour no matter how much it hurts, but the treatment becomes quite another matter when children or adults of kindred mental attitude are concerned.

I have had no trouble with such an individual provided only I could get him interested in the attempt to score a higher record than his nurse when blowing into a tube connected with a mercury manometer. Of course no forceful expiration is possible unless preceded by a correspondingly deep inspiration, hence the value of this little subterfuge becomes apparent at once. The mercury goes higher every hour, the increase in distance being a matter of astonishment to the one who observes it for the first time. There are, as a matter of course, surgical patients who are too ill for this sort of treatment. In these only those measures which fulfil the individual requirements can be instituted.

Painful respiration is caused in most instances by pleurisy, but in making the diagnosis of the condition the factors mentioned above must be seriously considered and the probabilities of an intercostal neuralgia or actual bruising of the muscular or other tissues must be considered.

Schepelmann[3] states that in dry pleurisy, especially, the pain is increased on bending the body towards the well side, while in intercostal neuralgia there is more pain when the body is bent towards the affected side.

Treatment consists in first utilizing the apparatus mentioned above, and the patient is encouraged to bear with the discomfort for a few hours at least. Usually the condition improves steadily from the first efforts at treatment and no further measure is necessary.

If there are symptoms necessitating more radical measures as is seen, for instance in beginning pleurisy at times, dry cupping is resorted to at once and kept up twice each day until the distress has ameliorated. Strapping the chest is resorted to when cupping is not employed, but this latter maneuver has never given the relief so far as I have observed, that may be accredited to the former.

The cases of intercostal neuralgia may require more than putting the side at rest by means of adhesive straps. When the pain is persistent, even in the face of such treatment, it may be necessary in a few rare cases to inject the nerve itself with a mixture first brought to my notice by V. P. Blair. This consists of novocaine, 10 gr., chloroform, 20 minims, alcohol 6 drams, to which freshly distilled water is added until one ounce of the mixture is obtained. It is injected into the nerve sheath by means of a very fine needle. The relief is said to be instantaneous. In carrying out this operation the patient's mental attitude is to be considered, as the distress which it causes is so great occasionally as to even preclude its use. In such cases it will usually be found that the pain can be eliminated by the other simpler means. In true neuralgias, however, the patient will not object to the treatment, especially if the area of injection is first anesthetized with a little ½ per cent novocaine.

Localized soreness, not a pleurisy or an intercostal neuralgia, is best treated by massage. Hot applications in the form of the turpentine stupe or hot-water bag are also useful. Liniments as employed for sore jaw may be applied where the hot water application is not practical.

Anesthesia Paralysis.—Anesthesia paralysis is usually not a permanent affliction, though a particularly distressing one and possessed of a medicolegal aspect. This complication is due only indirectly to the anesthetic. The injury itself, which results in functional loss to the various nerves of the body, may be produced by the position of the patient on the operating table or pressure on localized parts of his anatomy.

Probably the most common etiologic factor is the careless practice of many anesthetists of allowing an unconfined flaccid arm to drop down and hang for a time over the edge of the operating table. Such treatment frequently causes extensive pressure to be exerted upon the musculospinal nerve while the brachial plexus is also a frequent sufferer from mechanical injuries during anesthesia, this being apparently more often affected than is any individual nerve.

Its frequent occurrence in women compared to men causes Molinari[4] to state that women seem more predisposed to this complication.

The injury to the plexus is produced in a variety of ways. No doubt the most common method is the extension of the arms above the head as is so often seen during the use of the Trendelenburg position. The actual condition as stated by Büdinger[5] reveals that during such a maneuver the trunks of the plexus are pinched between the clavicle and the first rib at the point where these cross the rib. By further extending the arms the clavicle rotates upon its transverse axis until in the most extreme extension the posterior superior border becomes the inferior posterior, thereby limiting still more the area between the two bones and particularly compressing the upper and posterior cords of the plexus. In his discussion of this subject he further calls attention to the fact that in some patients there is a peculiar formation of the clavicle and thorax which permits of an increase in pressure during this position. He also found that by bringing the head towards the side of the abducted arm the corresponding nerves escaped compression by slipping outwards and from beneath the clavicle. Drawing the head to the opposite side did not produce these same results.

Other German[6] authors believe that compression by the transverse processes of the vertebra of the fifth and sixth cervical nerves as they leave the spinal column is a common cause of brachial plexus paralysis. Such an accident is likely to occur they state when the arms are extended over the head during anesthesia.

Postoperative paralysis may result from temporary pressure of the head of the humerus on the brachial plexus below the clavicular portion following hyperelevation of the arm over the head with rotation inward according to Glitsch.[7] The median nerve is particularly liable to injury as it passes over the head of the humerus in this instance, then while bending the elbow and rotating the arm outwards, the ulnar nerve is exposed to injury.[8] Traction on the plexus can be brought about by various faulty positions of the arm during operations upon the breast, shoulder joint, etc., also in such instances the actual operative procedure is, of course, a matter to be taken into consideration.

Paralysis of all the nerves of both arms have been reported. Bernhart[8] notes such an instance where the arms were maintained above the head during a Trendelenburg position for one and one-half hours. Halstead[9] also observed such a case in the practice of one of his friends. I also once saw a double palsy follow an operation in which both hands were firmly held above the patient's head during an operation of long duration. The malady lasted more than a year on one side and several months on the other. In the case observed by Halstead[9] the paralysis disappeared within one year. Such experiences tend to make the observer uncomfortable whenever he sees the upper extremities so treated in the course of an operation which might be equally as well performed with them at the patient's sides.

Paralysis may result from pressure on any motor nerve in the body. Flateau[10] reported a case of bilateral facial paralysis following pressure of the anesthetist's fingers. Injuries to various thoracic nerves may result from the position of the patient. Halstead[9] says "that the lateral or lateroprone position maintained over too long a period may be instrumental in producing compression of the brachial plexus, trunks, and individual nerves, the circumflex and radial being particularly exposed to danger. The popliteal and other nerves of the legs are also liable to injury from pressure of the table during the Trendelenburg position. The patient often hangs with all the weight borne by the lower legs unless shoulder crutches are used. In strapping the thighs preparatory to an anesthesia the possibility of nerve injury exists unless slight pressure be employed."

"The rarity of any similar lesion in the lower extremity coupled with the observation that arms are frequently, and legs seldom, subjected to the strain of most unusual positions on the table, leads to the obvious conclusion that the upper extremities should always be rather loosely confined at the recumbent patient's sides when the execution of the operation is not hindered thereby. To be sure, there are conditions of anesthesia, under which the necessary handling of a patient becomes so difficult as to leave the attendants little choice as to just how the arms should be held; while on other occasions the necessity of keeping some unusual operative field exposed may preclude the possibility of an easy position for both shoulder regions. Under such circumstances, of course, the surgeon can only accept the better of the two possibilities and hasten the operative work as much as consistent with thoroughness."

"The mechanical factors involved in these cases are in each case so prominent and our efforts to eliminate them so strenuous that other causes of the same condition are almost overlooked. It has been considered especially by a few French observers that the ether itself through its toxic action on the nerves, lowers the resistance to trauma, which predisposes to the paralysis. The condition was more common in the days of chloroform anesthesia and would occur days and even weeks after its administration. Molinari[4] does not consider the theory tenable, nor in view of the evidence in favor of mechanical injury would we consider that the anesthetic played a very important role in the actual production of the malady. The fact that paralyses occur so long after the operation gave color to the French contention, but at times exactly the same phenomena occur following any anesthesia."

Halstead[9] to whom we owe so much considers a central paralysis which may occur *during* the administration of a general anesthetic. He states that the condition is rare and that we have little direct evidence as to the cause of the disease. Two hypotheses he says are to be considered: "First, that the lesion is due to ischemic softening, following a hemorrhage. Secondly, that there is a primary degeneration the result of toxic action of the anesthetic upon the cerebral cortex. When hemorrhage is the cause of the paralysis, we must assume an existing sclerosis of the vessels, which give way usually during the stage of excitation of ether narcosis." Instances of this latter accident have occurred more often than the former. Many, no doubt, have accredited it to the narcosis when the condition would have come about had this not been attempted. Buxton[11] noted two patients in whom this happened previous to the operation. Others have also called attention to this malady in the instructions given for the preparative care of their patients.

It is possible that a previously deranged nervous system does play a role in predisposing to paralysis, as witnessed by the fact that I recently observed a marked brachial palsy affecting a highly neurotic individual who was carefully watched during the anesthesia, and who experienced none (to our knowledge at least) of the ordinary exciting factors common in these cases. He had a syphilitic history, as it appeared to me.

The treatment concerns itself first with the prevention of the malady. If this is kept in mind during the arranging of the patient on the operating table, there need be slight fear as to a good outcome. I never allow the arms to be drawn above the head for any operation. In instances where the Trendelenburg position is used, carefully and thickly padded shoulder crutches are employed. For breast operations the arm rests comfortably on a padded support placed at right angles to the body. For every other operation the patient is carefully observed to make sure that there is sufficient padding under the parts exposed to pressure and a position assumed most comfortable to him and at the same time least objectionable to the surgeon. No one allows a leg or an arm to hang unsupported in this day of preventive medicine. Careful study of the patient, leading to a thorough knowledge of the condition of his nervous and vascular systems, will insure measures to correct abnormal conditions and thus prevent most of the paralysis due to central causes.

When the accident occurs despite every effort put forth to prevent it, treatment must be instituted at once and persisted in until the signs and symptoms have disappeared. In many instances the normal is not obtained for several months after the condition presents itself. The actual measures for its alleviation consist principally in massage, electrotherapy and attention to the general health of the individual.

Pressure and *tension* are as a matter of course to be avoided, since no patient who is not reasonably comfortable can be expected make a satisfactory convalescence. Pressure may in addition to being a source of discomfort become exceedingly serious, especially when carried to the point of cutting off blood supply. Where bandages are used on the extremities, the toes and fingers should be left exposed in order that change in color or temperature may be readily and quickly detected. In case they become blue or cold every constriction is to be cut at once no matter what other factors come into play, since more than one instance of gangrene has followed the postoperative swelling of an extremity which remained too closely confined. Volkmann's paralysis is a particular form of trouble which occurs in the arm when pressure ischemia is maintained for too long a period in the muscles. The usefulness of many a hand has been lost after the fingers have assumed a claw-like posture resulting from permanent contraction of flexor muscles due to muscle substance being replaced by scar tissue in consequence of the accident just mentioned.

Pressure is particularly obnoxious over bony prominences, particularly is this true about the knee, ankle, and heel. An experienced dresser is always at pains to carefully and thickly pad these prominent points, as well as all those presented by the bony pelvis, before applying a plaster cast.

The heel of a patient who is to remain for a long time in the recumbent position should be prevented by padding higher up on the limb, from touching the underlying bed at all. Prolonged contact with the bed is sure to occasion discomfort, and if not corrected, in the course of time is very likely to lead to loss of substance. We have in many instances been reminded of the fact that more discomfort and uneasiness may result from such faulty handling of a patient than from the fracture which necessitates his stay in bed.

The placing of restraining sheets over the limbs of very lean patients often results in serious injury to the vessels or nerves. In this connection the tourniquet should be mentioned. In rare instances injury to the musculospinal nerve has resulted from insufficient protection of the arm from the constricting band, especially in cases where this has been placed too low down and at a point where this nerve encircles the humerus.

Tension if extreme and too long continued leads to unrest on the part of the patient and at times to much more serious consequences. Stitches which are too tightly tied inevitably cut through and not infrequently lead to serious nutritional changes along the wound edges.

A high abdominal wound if closed with too much tension prejudices the individual's safety in no uncertain way. The movements of the lower chest wall are greatly interfered with, resulting in deficient ventilation of the lung with a consequent marked tendency to pneumonia. I was so unfortunate as to lose one of my early postoperative hernia patients because I overlapped for too great a distance the edges of a postoperative hernia ring situated in the gall bladder region. A second patient in whom a similar error of judgment was made seemed to be following the same road when his paroxysm of coughing broke the stitches with the result that he rapidly improved and demonstrated in no uncertain way the truth of this pathologic reasoning.

The amount of tension which may be exerted upon an extremity is almost unbelievable provided merely that the patient be very gradually accustomed to it. In the old days when we applied ten or twelve pounds to an adhesive strap on the skin of the lower leg we considered that we were doing all the patient could expect, and indeed, met at times with decided remonstrance. I have, however, in recent years made extensive use of the bone pin first suggested by Codavilla upon which a pull of fifty pounds has been exerted after gradually increasing the same for a period of four weeks. I can not say, however, that I have seen a patient thoroughly comfortable after the thirty pound limit was passed. A great deal more can be done in this direction if one commences before the reparative process has set in, whereas tension measured by only a few pounds is apt to cause acute suffering if a fracture is three or four weeks old before the treatment is begun.

Full credit is due O. F. McKittrick for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER VIII

SLEEPLESSNESS

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Sleeplessness is seen so frequently in postoperative patients that one is more or less inclined to regard it as a normal occurrence rather than a malady demanding careful attention. As a general rule this subject is not brought to the attention of the attending surgeon for several days after the operative procedure. Usually on entering the hospital if the patient is concerned about the operation or is at all nervous or restless, veronal, gr. v, is given at 7 P.M. in a glass of hot milk, the night before the operation. The drugs given for the relief of pain during the succeeding days are sufficient to eliminate any disturbance which would in any way preclude sleep.

After the third postoperative day, however, and unless the patient is in the hands of a competent nurse, one often hears complaints that the patient does not sleep *at night*. It is always to be anticipated that such complications may arise in any patient who has been taken from the ordinary pursuit of life—howbeit an active one—and suddenly confined to bed. The rest, therefore, secured in the daytime and the periods of sleep snatched off and on during this interval leaves the patient wide awake at a time when, under ordinary circumstances, he would be asleep. A good nurse, expecting such an outcome, will so entertain her patient that the daytime naps are cut short and he is prepared in the most comfortable manner at bedtime. To do this the bed is carefully arranged to the best interests of the patient, the feet kept warm, an alcohol rub given, or often the nurse resorts to gentle massage, particularly of the back. This may or may not be followed by the reading of some light story, either by the nurse or the patient himself. At a regular time the room is more thoroughly ventilated, the lights turned low, and sleep is demanded by the nurse and invited by the patient. In the handling of these patients their individual temperaments and former modes of life are to be minutely considered.

It has been said that "direct causes for this malady do not often exist though they can sometimes be found, but indirect causes of many kinds are present in nearly every case." It becomes, therefore, a dire necessity to know more about a patient's habits before we can arrive at a definite conclusion as to the right course to pursue. The habit of taking several cups of coffee or tea or other stimulating drinks may be one fruitful cause of the condition. Certainly such is to be thought of and properly met in every instance. Occasionally, and particularly in old people or in those accustomed to drink, it is very essential that they are not deprived of their drink at this time, since a cup of coffee or tea or a little hot toddy often brings sleep when other measures have failed.

Some patients have the habit of sleeping during the late afternoon. This prevents further sleep until late at night or in the early morning. These patients, of course, are not allowed to pursue this custom when it results in sleeplessness, but are kept awake until the regular hour for sleep.

Another cause of sleeplessness in postoperative patients is lack of food. This is seen especially in very thin emaciated patients. The wait from the 6 P.M. meal to breakfast is too long. In these cases a glass of milk, a cup of cocoa, or other easily assimilable food is conducive to perfect sleep. These patients are more apt to be awake during the early morning hours and the food given at this time is efficacious. In this connection the evening meal is more often insufficient than too heavy as a cause for the patient's wakefulness. Food in itself rarely causes the patient to be awake. It is proverbial that animals sleep better with a full stomach, and the same very aptly applies to human beings. Of course, the diet must be so regulated that the stomach already weakened by the operative procedure is not overloaded with indigestible food, but the practice of denying nutritious food, especially during the daytime, to these patients or even at night, because of the fear that it may cause disturbance in sleep, can not be too heartily condemned. On the other hand, the recognition of the fact that inadequate food is the cause of wakefulness can not be too emphatically extolled.

Worry is indeed a fruitful cause for sleeplessness. Worry about the ultimate outcome of the operation, strange as it may seem, is not so prominent in their minds as the fact that they do *not* sleep. Such patients usually will have experienced this condition before they entered the hospital and on careful investigation one will find that they fear some permanent injury as a result of their wakefulness. Often they will state to the doctor that they sleep very little during the night and consequently feel that they are losing hold on the vital forces which are so necessary for their recovery from the operation or even future health. They become very solicitous as to the nature of the malady and implore their physician for relief. They may not have really lost very much sleep but complain of wakening so often during the night and never going *back to sleep.* It will be noticed, however, that they do finally go to sleep, and the length of time they were awake is only magnified and apt to have been thought much longer than it really was. That the statements of these patients can not always be taken too seriously is borne out by the statement of Walsh,[1] who says that, "We have no idea as to the length of our sleeping periods, and if we awaken a dozen times during the night we are likely to think that we have been wakeful most of the night, though all the wakeful periods may be embraced within an hour, and the rest have been spent in sleep."

In these patients I try to verify their statements by having them watched by the nurse whose findings are always more to be relied upon than the neurotic patient's ideas.

Occasionally one finds his patient concerned about sleep during the coming nights he *is to spend* in the hospital. He will start worrying and "just wondering" if he is going to sleep when that time comes. If one makes rounds along late in the afternoon he is more apt to see these patients at the time when they are in their zenith of anxiety concerning the sleep they will *not* get with the coming of the night. This certainly is ridiculous and is trying for those in charge of a sensible patient who is addicted to this miserable habit, nevertheless it is one to be reckoned with and combated as best the nurse knows how coupled with whatever therapy the doctor can advise.

This class of patients really do lose sleep, not because of any real physical difficulty, but because of the fact that they worry over the insomnia itself which is sufficient to bring whatever dire results such a condition entails.

The worry of the *effect* which the patient imagines insomnia will produce on his mind and body, is another factor which materially adds to the seriousness of the situation. Naturally the general condition becomes run down, the convalescence prolonged, and the patient considers that his sleeplessness is to blame for the condition, when as a matter of fact, the *fear* alone is the cause of his unhappy state. As soon as the thought of impending mental affection is eradicated from the patient's mind, the wakefulness will become easy to control. Insomnia, to be true, has occurred during the course of this malady. Personally I have never seen it follow postoperative insomnia. Walsh states that he has seen it develop as one of its symptoms, but not even then until other marked signs of mental affection were present. He further states that "Wakefulness is really a passing symptom of functional nervous condition that never leaves serious effects," an observation in which I can entirely acquiesce when the ordinary postoperative patients are alone considered. Such information often helps the patient to calm himself, and is one of the arguments employed in assisting him to regain a stable equilibrium when other measures as instituted below are utilized to complete the successful treatment of the case.

One of the most common causes of obstinate insomnia in cases not operated is errors of refraction according to Pronger[2] who states that it is not the gross errors which so often lead to the condition, but rather the slight ones, such as do not lead to such visual defect as to demand the wearing of glasses for their correction. The continual effort in the use of the eyes leads to a cumulative nervous strain which results in sleeplessness. Unfortunately these patients fall into the hands of the surgeon for various operations, and unless such a cause is considered possible, the patient may suffer unnecessarily even to the point of a general breakdown, and Pronger states that even suicide has been perpetrated by patients suffering from insomnia due to this cause alone. I have never had such an accident occur though on one or two occasions patients have intimated that this might result if sleep did not become more satisfactory. Clarke[3] in supporting Pronger states that the unconscious correction of small refractive errors always leads to waste of the nerve energy sooner in those whose nervous organization is more delicate than in the robust, in whom it may never present itself. This statement, however, should not prevent one from examining the eyes in the latter class of patients when other causes have been exhausted.

Gubb[4] in discussing the same subject calls attention to the fact that, not only does this trifling disturbance produce insomnia, but also others even less so will cause the same distressing symptoms. A loaded rectum, especially where there is a tendency to flatulence, tends to excite peristalsis and result in wakefulness. Williams[5] notes that toxemia resulting from a severe colitis may also produce this same condition. In fact the sleeplessness associated with bowel disturbance due to operative procedures is well known, probably as a result of autointoxication as well as the increased peristalsis necessarily produced.

The after observance that the height of the head can not be ignored if sleeplessness is to be avoided in some patients is also brought out by Gubb. The temperature of the room is important. A cool or rather cold room is certainly desirable for a normal sleep, and the free circulation of air is by all means to be obtained. Cold air, however, coming in contact with exposed surfaces of the patient's body is not conducive to perfect sleep or future health of the patient, and measures taken to prevent this happening are always observed in postoperative cases.

Further causes for sleeplessness may be found and corrected when some of the theories of sleep itself are brought to mind and briefly considered. Savage[6] states that normal sleep depends upon a healthy blood supply to normal nerve cells, particularly those of the frontal lobes. He considers that blood supply to the brain has most to do with sleep and recalls that sudden loss of this body fluid will produce insensibility, or pressure on both common carotids will cause the same phenomena. Howell[7] found that the brain became anemic and the blood pressure dropped during sleep. The skin in the meantime contained an increased amount of blood, which shows that the vasomotor system is in some way involved. Hill[8] considers the vasomotor center as the "hub around which turns the wheel of a man's active mental life." Savage suggests that there may be a venous congestion which produces a malnutrition of the nerve cells which is as capable of producing sleep as anemia. Miller[9] would consider "cerebral stasis" as a more likely cause of sleep than cerebral anemia the result of the stasis bringing about practically the same cell changes as the former condition. Stoddart[10] supports the theory that there is a carbon dioxide poisoning of the nervous system during sleep. In discussing this theory he recalls the habits of animals in their mode of producing sleep. In every instance the normal supply of oxygen is shut off either by burying their noses in hairy portions of their body and at the same time twisting the body so as to get the minimum amount of oxygen into the lungs. Birds tuck their heads under their wings.

Man becomes sleepy in stuffy rooms, and how often one finds patients sleeping with the head completely covered. He directs attention to the fact that patients suffering from diseases in which there is deficient oxidation such as in nasal obstruction, heart disease, anemia, etc., sleep soundly, while those suffering from fever and other conditions in which chemical changes and oxidation take place too readily suffer from sleeplessness. Stoddart has shown that by directing a noiseless stream of oxygen to the face of a sleeping patient by means of a rubber tube attached to a tank of oxygen, he can cause the patient to awaken in every instance within forty respirations, even though the stream of oxygen is not allowed to play directly on the face.

Bramwell[11] staunchly supports Stoddart in his resuscitation of the carbon dioxide theory of sleep and in the discussion on this subject he states that this phenomena is much too complicated a process to present a single factor for its origin. He considers almost all the theories advanced "are equally important and must exist together and at the same moment in order to produce healthy or natural sleep." If there is one theory more important than another, he would place, perhaps, "psychic calm," for "if this is absent two other conditions essential to sleep must also be absent; namely, a lowered or a certain required blood pressure and cerebral anemia or stasis." Bramwell suggests that "patients whose ocular muscles are intact and therefore without danger of strain, should turn the eyeballs upwards, with the lids closed as in sleep. This will promote a feeling of drowsiness" while, as so often experienced by all of us, "to turn them downwards causes an opposite effect, with tremor of the upper lids and a tendency to squeeze the upper and lower lids together."

Treatment further than has been suggested above may become necessary to relieve the minds of these unhappy and often apprehensive patients. The drug treatment is to be avoided if this is possible. Probably the first measure to be attempted is to find the *cause* of the condition. This is as important in the convalescent surgical patient as in those sufferers from medical causes alone. Any pernicious habit is so far as possible, corrected. Hygienic measures as suggested above are rigidly enforced and the patient when fixed up for the night lies perfectly quiet in anticipation of sleep. He attempts to leave his mind a blank and no disturbing thought is allowed to remain a single moment.

Turning the eyeballs upward as suggested by Miller or slight pressure on them by the nurse may in some instances be conducive to hastening sleep in the very nervous individual whose mind naturally is overactive. Hypnotism[12] is suitable in some cases, and when intelligently administered has been extremely valuable in some instances. Suggestion is another factor which must not be underestimated in patients whose confidence and perfect trust has been secured by the doctor or the nurse.

The gastrointestinal tract should never in any instance be neglected. Autointoxication from excretory products is carefully guarded against by keeping the bowels open, giving a carbohydrate diet if an excessive putrefactive process is suspected, and other eliminative measures actively and consistently carried out.

In this connection I would not fail to note the patient's hunger and at once supply food. Usually liquid foods, hot and in some cases a placebo, such as a little nutmeg sprinkled over the fluid will give an additional assurance of the patient's rest after the food is given.

If, however, some solid food is demanded, this, too, is not denied so long as actual indigestion does not cause more disturbance.

The eyes should not be overlooked in any case where there is any suspicion of trouble. The assistance of an oculist will solve many hard problems in dealing with some of the most intractable cases.

Hydrotherapy is often followed by good results. A warm bath before retiring or a sponge by the nurse, followed by an alcohol rub, gentle massage or both, will be rewarded by good results. The value of the hot foot bath resorted to by many patients is well known. Some even employ the mustard bath to the point of getting a general redness, a practice which I have never been compelled to utilize in the postoperative patient.

The drug treatment is employed as the final resort. If there is pain, this, of course, is at once relieved without delay. I have found 10 grains of aspirin combined with 1 grain of codeine indeed very efficacious. The codeine is alone repeated if it becomes necessary. Opium suppository (1 grain) will often give relief in abdominal or pelvic cases, and at the same time the patient is not aware of any medication given. Where there is painful peristalsis, paregoric, 1 dram, given each hour will relieve, and permit sleep. Chloral hydrate, 30 grains, per rectum in a little oil may be employed in those patients not suffering from pain. Paraldehyde, 60 grains, may also be given, either by mouth or rectum. Veronal or sulphonal, 5 grains each, given in hot liquids is frequently employed.

The bromides, given during the day and at bedtime, have been used for sleeplessness since medicine first came into existence. I often follow this old-time custom, and in many instances meet with success. The bromides, however, are slow in their action and can not be relied upon in all cases of malady appearing in patients who have gone through a major operation.

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CHAPTER IX

HICCOUGH

By O. F. McKittrick, St. Louis, Mo.

Hiccough (singultus, hiccup) occurs frequently after abdominal operations. As a rule, it is an unimportant malady, one characterized by mild and transitory attacks, which cease automatically or else is amenable to the simplest treatment. However, it may be the forerunner of the gravest complication, whether associated with, or in the absence of, some form of chronic disease, the affection, either in its acute or chronic form, becomes extremely distressing if it persists over long periods of time and occasionally this happens despite every effort made to control it. The exhaustion which is necessarily entailed may lead to the fatal termination of an otherwise normal convalescence.

According to most observers, hiccough is produced by sudden, involuntary clonic contractions of the diaphragm, with which the normal action of the vocal chords fail to synchronize. The unexpected descent of the diaphragm further increases the negative pressure in the chest into the viscera of which the outside air rushes but is partly checked by the nearly closed glottis. The air which enters causes sudden vibration of the vocal chords, the characteristic coarse sound being thereupon emitted. It is considered by some that there is spasmodic contraction of the abductors of the cords which completely stops the entry of the air, but Carr[1] thinks this improbable.

There is a double nervous mechanism which is concerned in hiccough. According to Sajous,[2] the vagospinal nerves bring about closure of the glottis and contraction of the stomach with accompanying relaxation of the pyloric sphincter. The phrenic nerve controls the diaphragm and a center which coordinates these movements is supposed to exist in the medulla, its action being stimulated by impulses from numerous efferent nerves which are indirectly connected with it. Irritation from the absorption of toxins or from any other source may bring about this condition by stimulation of the phrenic nerves at their origin in the fourth cervical nerves anywhere along their course to the diaphragm or in their terminal fibers in the under surface of this muscle.

Stimulation of the third or fifth cervical nerves, will also theoretically bring about such a result. It therefore follows that reflex stimulation may occur through the branches of the vagus nerve, particularly its gastric terminations, or irritation in any organ or tissue supplied by this nerve, may cause like phenomena. Stimulation of other visceral nerves as those to the uterus, bladder, kidneys, etc., or involvement of the peripheral sensory nerves may through reflex action bring about hiccough. Stimulation of the center controlling these phenomena may also produce this condition.

The most frequent cause is reflex stimulation of the phrenic nerves through the gastric branches of the vagus. Hence very hot or very cold fluids, an excess of condiments in the food whether fluid or solid, overeating, or the retention of undigested food particles in the stomach, distention of this organ or any irritative factor in the intestines, such as feces at times, an enteritis due to parasitic infections, etc., may be fruitful inciting causes. Functional or organic diseases of these viscera, associated with an overlying irritated peritoneum, particularly that on the diaphragmatic surface are common causes.

Bassler[3] reported two cases of persistent hiccough due to a hyperesthesia of the stomach. The condition which he named "singultus gastritis nervcsus" was one associated with loss of weight in the patient caused by the constant irritation of the food, etc. The condition is very rarely met, but it may be a source of some obstinate case and should be borne in mind.

Persistent hiccough is usually of grave import in peritonitis, particularly if associated with some abdominal malady. In a case observed hiccough persisted two weeks just before death of the patient after an exploratory laparotomy in which was found an inoperable carcinoma of the stomach. Although the peritoneum was free at the time of the laparotomy, at autopsy, three weeks later, there was quite extensive involvement. Another case in which persistent hiccough occurred was seen in a patient suffering from inoperable carcinoma of the bladder. The hiccough developed one week after an exploratory operation and persisted until the patient's demise two weeks later.

It usually comes late in a disease and at a time when the abdomen is distended. Particularly is this true in intestinal obstruction, ulcerative conditions of the intestines, pancreatitis, diseases of the uterus, prostate, or bladder. Marion[4] believes this symptom occurring after operations on the urinary tract is in the great majority of cases, a uremic manifestation; hence in patients suffering from chronic kidney diseases, this symptom is particularly ominous. The condition may intermit for varying lengths of time, and recurs without apparent reason; after several days of suffering during which the patient loses considerable weight, he becomes very much enfeebled. It, however, not infrequently causes death in such cases without the symptoms ever becoming abated. The comparatively frequent occurrences of hiccough in fatal cases where there are extravasations of urine after an operation for the relief of stricture, is, no doubt, due to some associated kidney lesion.

Diseases of the thoracic viscera may cause this symptom. Affections of the pericardium or diaphragmatic pleura especially may result in distressing hiccough. Contamination of the blood by toxic or infectious materials such as those produced in pneumonia or general septic infection may produce this phenomenon. In such conditions it seems probable that the nerve *centers* are involved as well as the diaphragm or the nerves themselves. In operative patients who are suffering at the same time from gout or diabetes, the blood, especially, plays an important role.

Local irritations from abdominal or pleural pus collections not uncommonly cause irritation of the nerves which supply the diaphragm as do tumors located in the mediastinum, in the neck, or in the lungs by pressure on the phrenic nerve. Green[5] reported a case of hiccough which persisted for six months and ended in death of the patient. At autopsy a small malignant growth was found at the hilus of the lung which evidently had caused the irritation of the phrenic nerve.

Hiccough may be due to central irritation or to reflex stimuli in neurotic patients. It may occur in hysterical patients or those suffering from epilepsy. Cerebral tumors[6] occasionally bring about such a condition or it may follow shock, some emotional disturbance, or organic functional disease of the nervous system. In a case of persistent intermittent hiccough seen, every known measure was employed to stop the paroxysms. The patient's blood was examined for syphilis and showed a negative Wassermann. Certain signs suggested a tabes dorsalis. In spite of the negative blood findings, antisyphilitic treatment was instituted with prompt amelioration of the symptoms which never returned.

Peripheral irritation in neurotic patients may result in the appearance of these symptoms. I have seen hiccough follow exposure to cold, especially to sudden chilling of the body, after bathing in cold water. O'Reilly[7] reported a case which was being treated for hepatic cirrhosis; hiccough persisted despite the usual routine treatment. Finally the ears were examined and impacted wax was found and removed. The hiccough ceased without further treatment.

Hiccough occurs in too many conditions to attempt to name them. As King has said, it may occur in almost any acute or chronic exhausting disease. The condition may be of little importance in the everyday routine of life, but after operation it should be especially enjoined that in every case, the *cause* of the condition should be determined if possible, and this corrected before the patient passes beyond relief, because of exhaustion or on account of the disease which is producing the symptoms.

The remedies employed for the treatment of this malady are legion. This is the best proof we have that no one remedy is effectual in every case. However, the measures which we will mention are those known by us to be worth trying under such circumstances. I have never failed to stop this symptom except on the two occasions mentioned above, and these patients were dying from inoperable cancer.

In most cases, the simpler remedies will usually suffice, among them may be mentioned the drinking of one-half glass of water in which a teaspoonful of sodium bicarbonate has been placed, swallowing of ice, sucking a lemon, taking a little vinegar or common table salt. Probably one of the oldest and most efficient of the common remedies is the holding of the breath while large swallows of water are taken. King suggested that the patient at the same time stop the ears with his fingers while his nose is held tightly closed. Air is thus prevented from entering the pharynx except through the mouth. If two or three trials fail to stop the symptoms, the tongue should be thrust out synchronous with each respiration, which should now be increased to 30 to 50 per minute. Each respiration should be deep. This however, exhausts the patient and should not be kept up very long at a time. Massage along the course of the phrenic nerves in the neck or counterirritation with mustard leaves here as well as over the epigastrium may prove an efficacious treatment.[8] If the symptoms continue, the alimentary tract should be freed of all material which can be the causative factors. If the nature of the operation permits, free catharsis may be instituted by giving purgatives per mouth, otherwise, enemas will suffice. The stomach should be emptied. A simple emetic such as a teaspoonful of mustard in a cup of warm water may be tried at first. Apomorphine, 1/10 grain subcutaneously is particularly suitable in that not only is the stomach emptied, but the act of vomiting causes the diaphragm to contract violently and this alone may stop the clonic spasms. The tube may be used also for clearing the stomach, and in patients unused to it, this is especially indicated. With the gastrointestinal tract cleared out, other remedies can now be tried. Since so many different drugs have now and then acted well in different patients, it is probably advisable to continue the use of other medicinal measures. Inhalation of amyl nitrate or injections of cocaine, $\frac{1}{20}$ to $\frac{1}{10}$ grain hypodermically, may be tried.

By all means force the intake of large amounts of water, in which sodium bicarbonate is freely given. Other measures such as mechanical interference may be employed. Forceful manual compression of the costal margins of the lower ribs and the epigastrium at intervals of three or four minutes is good, or a tight adhesive binder may be placed around the lower portion of the thorax. Jodicke[9] describes a good method for obstructing the diaphragmatic movements. He forces the intestines up against this muscle by flexing the legs upon the thighs and has them flexed on the abdomen and pressed as firmly as possible against this part of the body. He reported a serious case in which this procedure was successfully employed. The hiccough stopped in ten minutes. The condition is relieved in many instances by the patient placing his arms above his head and then pulling his weight upward in the bed by holding to the head railing.

If in spite of all the measures suggested, the symptoms persist, the kidneys may be at fault and measures should be undertaken as described under the treatment of uremia. Should the symptoms still persist, then morphine must be resorted to. It should be given hypodermically until the full physiologic effects are seen. In one case that I have treated the respiration was cut down to four per minute, while in another it was diminished to only three per minute. One patient was cured and the other temporarily relieved. Caffrey[10] failed to stop the symptoms in a severe case by using this method, then he injected $\frac{1}{150}$ atropine sulphate subcutaneously and the symptoms at once cleared, never to return. The hiccough had persisted four years, and in this time every known remedy had been tried.

Chloral hydrate and the bromides have been used repeatedly with varying degrees of success. Recently, Segal used epinephrin, 10 drops of a 1:1000 solution, which stopped a hiccough which had lasted eleven days, even in spite of chloroform anesthesia. Lately, Mead[11] reported a case which was cured by menthol after none of the usual methods had brought relief. He uses 10 drops of a saturated solution of menthol in spiritus vini recti and this is repeated every hour if necessary.

In babies, hiccough may be stopped by giving them plain water. Grape sugar or granulated sugar placed in the mouth often stops the malady. In older children, the same measures are used as those employed for adults, except perhaps the medication. The mechanical measures should be persisted in for longer periods of time than with adults. Provoking sneezing may be efficacious.

In hysterical or neurotic patients, the treatment as suggested for older children should first be tried. Autosuggestion or hypnotism is indicated. Valerian is especially efficacious. Ether narcosis may be employed as a last resort in the usual persistent case of hiccough which is threatening life, but in these hysterical patients, it should be employed early in the condition. The hiccough rarely returns after the first narcosis.

The esophageal sound has been passed successfully in a few instances, one such was reported by New[12] at the Mayo Clinic, in overcoming a hysterical hiccough. The patient had been operated several times, for various conditions among which were appendicitis and stone in the kidney. After each operation, the patient had hiccough which lasted from one to twelve hours. After the last operation, hiccough appeared at short intervals for four months, after which date it persisted day and night for five months longer. The rate of the hiccough varied from 20 to 72 per minute. During this time many measures were tried to secure relief. C. H. Mayo advised intubation since he believed the nervous condition alone produced the symptoms. Following intubation with the largest size of O'Dwyer tube the hiccough stopped at once. Three hours later, the tube was coughed up and the hiccough started again. The tube was again introduced and remained eight hours in place, after which time it was coughed up but the hiccough did not return. The patient was permanently cured.

Intubation therefore is placed on the list of the many remedies for this condition, but no treatment should be left untried in the hope of finding something which will relieve the patient of a symptom which more than once has demanded death for its toll.

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CHAPTER X

HEADACHE

By O. F. McKittrick, St. Louis, Mo.

Headache is one of the most common symptoms with which the medical profession has to deal. It is natural, therefore, that it should present itself frequently in the postoperative patient, and for this reason we are forced into the discussion of a subject upon which volumes already have been written. However, a certain amount of familiarity with its various forms is essential, in order to intelligently carry out adequate treatment when the occasion arises. The disturbance may be very mild and transient in nature, not indicating any especially important upset in the patient's condition, or it may become quite severe, being the forerunner of some important complication. It often accompanies some serious constitutional disease.

This symptom arises as a result of an almost unlimited number of disorders, and the mechanism of its production is still one of the unsolved mysteries of medicine. It has been thought to be due to irritation of the terminal sensory branches of the fifth nerve or the vagus branch supplying the meninges. The pain most commonly complained of is a dull ache or throbbing in the head, but frequently it is acute, sharp, shooting, boring or stabbing. It may continue for a number of hours or days, but is more likely to be transient or paroxysmal in occurrence.

The location of the pain in the head is of little importance, according to Cabot.[1] Ocular headache usually begins or centers around the region of the eyes, whereas that due to inflammation of the frontal sinus, antrum, middle ear, or the periosteum, spreads from a point over the initial lesion. The headache may be confined to the temporal, parietal, occipital, or frontal regions on one or both sides, or it may be generally distributed throughout the whole head. It has been generally conceded that migraine is unilateral, but other conditions, such as uremia, brain tumor, neurasthenia, etc., may also excite a unilateral headache. It is apparent, therefore, that too much reliance in making a diagnosis of the causative factor or factors can not be placed upon either the kind of pain or the location.

For a practical working basis, I agree with Leszynsky[2] that headaches should be divided in two classes—functional and organic. Functional headaches are so varied and so frequent that to classify them is almost impossible. In this group are included those headaches due to conditions not located within the cranial cavity. Headaches referable to various constitutional or psychic disturbances are also included in this class.

The organic form includes all headaches due to intracranial disease, or disease of the skull.

Probably the most frequent form of functional headaches is toxic in nature. Under this class may be mentioned as exciting causes (1) operative concern, (2) ether, (3) fatigue, bad air, (4) insolation, (5) constipation and indigestion, (6) infections, (7) poisons, and (8) constitutional diseases.

Nervous individuals, and those patients who have worried over the oncoming operation, frequently develop a headache before etherization takes place. These same patients, because of any divergence from the routine of the postoperative treatment, such as entertaining visitors, sudden anger, disappointment, or what not, are aften noticeably victims of this unpleasant complication. Ether headaches very soon follow the narcosis, but do not, as a general rule, persist for a long time. Local anesthesia or spinal analgesia are more liable to excite this symptom than ether, and the effect, in my experience, is far more lasting. Fatigue and bad air do not go hand in hand, though the association is so common in these patients that one can hardly resist the feeling that with abundance of fresh air and sunlight, fatigue would often be delayed. Cabot suggests that the fatigue is due to the circulation of "fatigue poisons." In summer time, especially, and following a "heat wave," patients develop headaches which seem to be due to overheating. Most of such cases are, more or less, "nervous" and no doubt part of the distress is instigated by this affection.

The absorption of the excretory products of the body or fermentative or decomposing food within the alimentary canal certainly plays a most important part in producing this condition. Autointoxication from this source was long ago demonstrated clinically as a very productive factor in causing headaches. One of the first things to be considered in the treatment of the condition is to thoroughly eliminate these poisons by emptying the bowels and flushing the kidneys. Constipation *per se* does not always cause a headache, for patients very often go many days and even a week without a bowel movement without symptoms. On the other hand, others are very susceptible, and a very slight irregularity produces severe headache. Gastric or intestinal indigestion will cause headaches through absorption of the toxic material thus generated, through reflex irritation of the vagus or sympathetic nerves, or from gaseous distention of these viscera, due to the abnormal fermentation of the undigested food. Dizziness frequently accompanies the headaches produced by intestinal intoxication, and the urine in these cases will show an increase in the indican reaction. A decrease in the alkalinity of the blood, as seen in acidosis, or a retention in the blood of excrementitious substances, as seen in uremic patients, are likely to cause persisting and severe headaches, which are relieved only when the exciting causes are reduced by elimination.

Infection or inflammation, accompanied by fever, often produces acute headaches. In postoperative cases, it is usually the result of catching cold. Rarely it is the symptom of some acute exanthematous disease superimposed on the surgical operation. The height of the fever, the character of the pulse, and white blood count are important adjuncts in making a diagnosis.

The withdrawal of poisons, such as alcohol, morphine, tobacco, coffee, etc., usually exert their effects. It is not infrequently seen in patients long addicted to their use, and unless the demand is supplied, the headache becomes persistent and quite severe.

Constitutional diseases such as gout, diabetes, chronic rheumatism, or hypothyroidism may cause headaches at times.

Another form of functional headache comes under the heading of the psychoneuroses. This includes (1) neurasthenia, (2) hysteria, and (3) epilepsy.

Neurasthenia is fast becoming an obsolete term for vague nervous affections, which apparently have no cause for their existence. Headaches assumed, or in most of the cases actually experienced, are peculiar, in that so often only a fullness in the head, as Leszynsky notes, or a restricting band across the forehead. The disease increases in severity with the increased attention given the patient.

Hysterical headaches appear suddenly, and apparently are very severe, but of short duration, and are usually localized. Other signs of hysteria may accompany the symptom, such as convulsive attacks, muscular spasms, etc., the condition like neurasthenia is very favorably influenced by suggestion.

Epileptics frequently develop headaches following convulsions. This symptom occurred regularly in one of my patients, the condition, however, lasted but a short time, but the number of convulsions could be accurately ascertained by the number of times the headache appeared.

Functional headaches due to vasomotor disturbances are fairly common. Changes in the atmosphere, excessive hard mental work or worry, insomnia, venous engorgement from chronic heart disease, coughing, emphysema, or any act or condition resulting in obstruction to the venous return in the neck,[3] may cause the onset of this unpleasant symptom. Cerebral anemia following loss of blood at operation, as a result of posture, shock, or arterial disease, is very likely to produce headache, the severity and duration depending upon the extent of the anemia.

Migraine, sick headache, or hemicrania, is a form of vasomotor headaches, which stands alone in its tenacious persistence and severity of symptoms. It is said that the immediate cause is a spasmodic contraction of the cerebral, or other arteries, on one side of the head, followed by unusual dilatation of these same vessels. The disease is usually preceded by a few days prodromal symptoms of lassitude, irritability, feeling of fullness in the head, etc.: the headache gradually begins, and finally reaches a severity which is almost unbearable for the patient. One side of the head is involved at a time, though both sides may become alternately affected. The attack lasts several hours, and at times several days elapse before the pain disappears. The condition is a periodic inherited one, and a diagnosis is made by the history, character of the attacks, and location of the pain.

The last but very important form of functional headache is the reflex type. This includes the affections of (1) eye, (2) nose and pharynx, (3) mouth, (4) ear, also (5) gastric and menstrual forms.

Ocular imperfections are such a common source of headache that they must be seriously considered in every case not responding quickly to treatment. Astigmatism alone is one of the most common causes of persistent headache. It is usually aggravated by overuse of the eyes. Errors of refraction, inflammation of any part of the eyes, iritis, glaucoma, etc., are often followed by headaches.

Nasopharyngeal obstructions, inflammations, deformed septum, polyps, etc., are frequently the cause of headache, and especially in the chronic mouth-breather.

Carious teeth were found to be a cause of persistent headache in one of my cases. On removal of two teeth, the headache ceased at once, never to return.

Impacted cerumen in children has occasioned a disturbing headache. This condition has not been observed in any of our adult cases.

Gastric conditions producing headache have already been mentioned, but reflex hunger pain, exhibited in postoperative patients, is likely to be followed by headache, if the hunger is not appeased within a short time.

Menstruation is a common cause of headache, which usually occurs preceding or just following it. It is not a hard condition to treat as a rule.

Cabot, quoting Edinger, calls attention to headache which has been termed "indurative" and is associated with painful uneven nodules near the insertion of the muscles attached to the occiput. When these nodules disappear under massage, the headache is at once relieved. These indurations have been felt in a few of our cases after operation, and in each case they were accompanied by headache which was relieved by firm, deep, rotatory massage. The cause of the condition is not known, and so far as I have been able to learn, microscopic examination has not been made to explain the condition.

The organic headaches present a varying number of causes. Among the first to consider probably, is inflammation or disease of the frontal or ethmoid sinuses. The pain in these cases is most severe in front, and usually worse on the side most affected.

Middle ear affections and disease of the mastoid are frequently accompanied by headaches.

Diseases of the cranial bones or inflammation of the periosteum cause localized and persistent pain at times. The headache is more likely to be worse at night. Syphilitic periostitis is always a likely exciting cause in such localized affections.

Intracranial disturbances, which produce headache, such as inflammation of the meninges, particularly inflammation of the pia, is very likely to be infective in nature. However, affections of the dura, especially in old people, are likely to be due to syphilis. This type of headache is commonly periodical and paroxysmal in nature, worse at night, and there is usually a history of the disease for long periods of time. Cerebral syphilis produces endarteritis, with gummatous formation, either on the meninges or within the brain substance. In addition to the headache, other symptoms occur, such as vomiting, paralyses, optic neuritis, and possibly vertigo.

Intracranial tumors, other than gummata, are exciting causes, at times, of persistent and severe headache. The pain usually is somewhere near the location of the tumor, but occasionally the pain is general. Psychic excitement, stimulation of any kind, straining at stool or coughing, etc., always aggravates the condition.

The general diagnosis of the cause of headaches is extremely difficult in a large number of cases, and there is a still greater number of postoperative headaches in which a diagnosis is not made at all. These cases represent so large a number that it is discouraging to even attempt the enumeration of known causes.

Of cases which do not clear up under ordinary treatment, and in whom the etiology is obscure I would suggest that Cabot's following question be asked: "(a) Is the headache of paroxysmal occurrence and fixed duration (usually, twelve to twenty-four hours), accompanied by disturbances of vision and great prostration (migraine)? (b) Is the history that of a psychoneurosis? (c) Does the pain recur at precisely the same hour each day?" In addition to the general physical examination and blood for Wassermann in suggestive cases, he would add the following: "Examination of the eyes (including retinoscopy), (2) blood pressure determination (nephritis, tumor), (3) temperature record (infections), (4) urinalysis (albumin, sugar, acetone), (5) examination of the nose and its accessory sinuses and (6) palpation of the insertion of the nape muscles at the occiput."

The treatment consists first in an earnest attempt at diagnosis. As Schreiber[4] says: "Each headache has a different meaning, and when one considers that all the infectious diseases begin with headache, it is one of the most important symptoms with which we deal."

"Abrams[5] says that while the diagnosis is being attempted, the patient should be palliatively treated. Certain preventive measures can be carried out in surgical cases. During an operation the brain is being continually stimulated by the cutting of tissues and nerves which have not been blocked." Schreiber thinks this a very important cause in postoperative headaches, and in patients subject to this malady, nerve blocking may be attempted before the operation begins. At the end of the operation the stomach should be washed thoroughly with cool water, which not only cleans out the irritating ether mucus, but also gives tone to the more or less dilated stomach. The patient is then put into a warm bed, and kept comfortable. Surgical shock is another important cause of postoperative headache which Schreiber would overcome by the simple measures above.

If headache occurs in spite of the preventive measures suggested, the first attempt at treatment is to get the head cool with ice bags or cold cloths. This causes a constriction of the vessels in the beginning, followed by a dilatation of the vessels. At this stage, if the patient so desires it, the ice cap can be replaced by the hot-water bag. The feet are kept hot by means of hot-water bags, from the beginning of the attack, and measures begun to thoroughly clear the gastrointestinal tract.

Large doses of phenacetin, acetanilid, aspirin, etc., which so often are next in order, are not particularly subscribed to by Schreiber, since they are so likely to depress the circulation. He would use instead, bromides which are very efficient in allaying the reflexes and thus are very useful in the migraine form of headache. Migrainin, a mixture of antipyrine with caffeine and citric acid, in doses of 10 to 15 grains is also very useful.

In some instances adrenalin 10 to 20 minims, may be given hypodermically. This drug occasionally causes vomiting.

The congestive forms of headache, those due to arteriosclerosis or locomotor ataxia respond particularly well to concussion of the seventh cervical vertebra. Clinically this produces a vasoconstriction of the vascular system throughout the body, and especially that of the head. Schreiber states that the results are marked and by examining the fundus of the eye at this time, the vessels can be seen to constrict. He used this method successfully in relieving a headache due to a cerebellar tumor, which could not be removed at operation. Concussion of the tenth dorsal vertebra, however, causes a dilatation of the vascular system, and is attempted in cases which indicate such therapy. The method should not be employed until the other measures have been tried. The claims are based on clinical observations alone.

To concuss the spine, an instrument especially devised by Schreiber, is placed directly over the spinous process of the vertebra and then struck a firm blow with a rubber hammer, which is reinforced with wood. The blow is repeated ten times, after which a rest equal to five blows is enjoined, and then the process is again repeated. This is continued for three to five minutes. The treatment can be repeated every three to four hours, and kept up as long as necessary.

"In that type of headache which seems to involve the region of the occipital nerve, Abrams finds the most tender point along the nerve by means of firm pressure with some hard instrument, and then freezes it for three to five minutes with ethyl chloride. In diabetics or very run-down individuals, it is not frozen so long because of the danger of skin necrosis." Schreiber would repeat this treatment as often as the headache returns.

Finally, codeine or morphine may be resorted to if no relief can be obtained by the above measures. Stewart, however, would try to bring about sleep with the bromides and veronal or chloral, before the opium is administered. Opium certainly should not be used for this condition, since opium addiction is particularly liable to develop in such patients.

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CHAPTER XI

BACKACHE

By O. F. McKittrick, St. Louis, Mo.

Backache is a symptom commonly complained of the day following a surgical operation. In fact many patients give one the impression that this is their most distressing symptom. It is increased usually when the patient turns in the bed or in any manner twists the back or uses the muscles of this region. The pain is located in either the lumbar or sacral regions or both, and is often accompanied by rigidity of the lumbar muscles as noted by Da Costa;[1] the pain may persist for many days, being a fruitful source of annoyance and even wakefulness in the patient.

I believe I have heard this complaint by two classes of patients particularly (a) those who have had a general anesthesia (b) those who were lying flat on the back during the operation. This observation gives color to the theory that the normal curve of the spine is maintained by the muscles and ligaments acting together, hence deep anesthesia, by relaxing the muscles, imposes an undue load on the ligaments which are stretched beyond the normal degree if the patient lies on a perfectly flat table. Severe backache is the result. Other etiologic factors have been propounded by various observers. Among these may be mentioned renal congestion, congestion of the spinal cord, etc. Dunlap[2] states that the position of the patient on a hard flat table without a support causes undue strain on the sacroiliac synchondrosis, while Kosmark[3] considers the strain on the lumbar ligaments the paramount cause of backache in these cases.

Backache existing in patients longer than the first few postoperative days is a matter which demands more thorough attention than is usually given these sufferers. I have seen the malady persist for weeks, bringing about serious delay in the convalescence and at the same time inviting condemnation of the surgeon by the patient, until the cause of the condition was found and the correct treatment instituted. In these instances the backache, probably first started by the position on the table, is kept up by other causes and conditions.

Diseases long before cured and which had previously given severe trouble with the back may have been started anew by the operative procedure. This symptom which may have been prominent before the operation (which was probably performed for an entirely different malady) may cause such severe pain that the postoperative care resolves itself into the treatment of the backache alone. The malady is so commonly observed during the after-care of surgical patients that its cause whether due to the operative procedure or some chronic ailment of the patient must be determined and measures undertaken to alleviate the distress thereby produced. The backache may not even be mentioned by the patient until he is allowed out of bed. It matters little to the patient whether the pain is rightfully a postoperative complication; it is a condition to be successfully met by the doctor in charge of the case and a systematic study of the condition, therefore, can hardly be overlooked in a work of this kind.

The lumbar or sacral backache when not due to any of the causes mentioned above may result from the added strain of the operation on a neurasthenic type of patient whose general vitality may be so lowered as to seriously affect the nerve tone. In such patients, particularly of the female sex, Kosmark calls attention to the fact that any pelvic condition such as inflammations, exudates, tumors, uterine displacements, constipation, etc., may result in backache. Even in those individuals not so run down or upset by the operation, pathologic pelvic conditions such as those mentioned above are extremely important etiologic factors and this possibility must not be overlooked in patients who are suffering from backache and who were not subjected to a pelvic or gynecologic operation.

During the menstrual period, I have often noted an increase in the severity of the symptoms in an already aching back or a beginning of this malady in patients previously free of pain. In the latter instances the backache usually disappeared with the menses. Operations upon pregnant women are very likely to be followed by severe backache. In my experience I have not found adequate means to prevent this malady regardless of the treatment and care afforded such patients on the operating table. Williams[4] and others have noted the physiologic relaxation of the various pelvic joints during pregnancy and Goldthwait and Osgood[5] state that possibly always—certainly occasionally, during menstruation—this state of affairs exists. There has accumulated considerable evidence to prove that the pelvic articulations, particularly the sacroiliac synchondroses are true joints, having all the common joint structures as stated by Goldthwait and Osgood and "that this being the case, they are naturally subject to the same diseases and injuries as the other joints. When this is once appreciated and the character of the articulations is considered, and especially when it is remembered that the exact opposition of these is maintained almost entirely by the ligaments, the surprising thing is not that abnormal mobility and disease of the joints ever do occur but that they do not occur more frequently." In view of these findings it is not surprising that backache should occur often in this class of cases following the added strain on the ligaments from muscular relaxation due to the general anesthetic alone, to say nothing of any malposition the patient may have assumed during the operation.

In studying the cause of backache, trauma is a factor not to be lightly turned aside. I once knew of a patient aged twelve upon whom a tonsillectomy and adenoid operation was performed, who suddenly the next day developed a most severe backache which necessitated several days' stay in bed. It was finally learned after most thorough examination that the patient had fallen out of bed during the previous night. The operative procedure was carried out at the patient's home and was not in the care of a nurse. This probably accounted for the accident. Other instances have been brought to our attention where the patient sat down too hard or had fallen on the hard hospital floor.

In discussing other etiologic factors Goldthwait and Osgood further state that "a mere general lack of physical tone naturally predisposes to trouble of this sort, the bones are held in place almost entirely by ligaments and it is not to be wondered at that these relax and cause trouble as do ligaments of the knee or foot under similar conditions.

"In cases in which definite disease is present the same elements which predispose to the special type of lesion in other joints naturally favor the occurrence of the same type in the articulations of the pelvis.

"Tuberculosis has long been known to occasionally develop in these joints. The infectious form of arthritis may also extend to the pelvis in connection with the more general manifestation of the disease. The same thing is true of the atrophic or the hypertrophic forms of arthritis, although the latter is by far the more common. It is in this hypertrophic form that the joints at times become entirely fused and that the persistent sciatica or leg pains are so commonly seen. These referred pains are probably due to the pressure of the hypertrophic tissue upon the lumbosacral cord as it passes over the articulation."

Epstein[6] calls attention to these same diseases, however, affecting the spinal column, as a cause of backache. He ventures the statement that the general surgeon has removed appendices, ovaries and performed other laparotomies, where the patient might have been much better served by a spinal support or plaster jacket. As a matter of fact such a mistake was made in Bartlett's clinic recently. A male patient, aged 41, was admitted for pain in lower abdomen and back. A diseased appendix was removed, but this in no way alleviated his complaint. On closer examination after the patient had had severe backache for a week, a hypertrophic arthritis was discovered in the lumbar vertebra with absolute immovability in three of them. A plaster of Paris jacket was applied with perfect relief of all symptoms.

In the elimination of the various causes of backache which a postoperative patient may present, gout must not be forgotten. Myalgia of the lumbar muscles (lumbago) is another source for this symptom. The etiology is obscure though it often occurs, according to some observers, in patients with rheumatic predispositions. In considering lumbago, one must differentiate from any early osteomalacia. Weinstein[7] states that if this latter disease is present, there will be a waddling and uncertain gait and a shortening of the patient's stature. Continuing this subject Weinstein notes that "the rhachialgia of neurasthenia simulates lumbago, but the etiologic features of the latter disease are absent, and there is no aggravation of pain on straining, while there is usually exacerbation under emotion. Myositis, with gradual onset, presents stiffness or rigidity in the extremities and back. The pains are vague for a while, when they take on a more definite character and become localized in various muscle groups. As the muscular involvement rapidly becomes general, skin lesions and edema develop, the true character of the condition is soon appreciated. Malignant tumors of the cord, such as carcinoma, sarcoma, and myeloma, give rise to pressure symptoms, the significance of which can not long be doubted."

A floating kidney may also give rise to backache, especially if associated with a general splanchnoptosis. This latter abnormality alone will give rise to severe backache in the patient out of bed. The "enteroptotic habitus" of Mills, and the nervous and dyspeptic disorders will help one to claim this condition as the cause of the complaint.

Occasionally gallstone colic occurs in the convalescing patient who has been operated for some other ailment. Pain in the right shoulder region remains after the attack has subsided. An engorged liver, a pyloric stenosis, or mediastinal tumors may cause backache according to Weinstein. He also calls attention to thoracic or abdominal aneurysms as a cause in some instances. Neuritis even that produced by glycosuria may be a fruitful factor in producing backache.

A pelvic or ureteral calculus or kidney neoplasm gives rise to severe backache at times. Wollheim[8] states that the frequency of the malady diminishes as the tract is ascended. He also notes that in obscure cases of backache, masturbation must be considered an etiologic possibility.

Attitudes or postures play an important role in backache as has been noted by many observers. Goldthwait and Osgood stated with reference to the pelvic articulations that "when once it is appreciated that motion in these articulations normally exists, it is easily understood that such attitudes as standing with extreme lordosis, or sitting with the lumbar curve reversed, as in lounging, must cause strain on the sacroiliac articulations, which if continued will result in the same weakness and relaxation as is seen in any of the other joints under like conditions of strain. In stout persons, either men or women, the drag of the large abdomen causes lordosis with resulting pelvic joint strain and explains the frequency of the sacroiliac weakness in this type of individual."

The weight of large tumors will cause their presence to be felt very likely in some sort of back pain. I had one case of elephantiasis of the right breast which gave increasing symptoms of pain and backache in the thoracic and lumbar portions of the spine. Support of the enlarged breast gave only temporary relief. Permanent cure for the condition was the removal of the tumor. The patient was admitted for a hemorrhoid operation, but the backache was so severe that other operative measures were necessary first to relieve the severe symptoms.

Backache due to the changes in the position of the fifth lumbar vertebra condition called by Killian,[9] spondylolisthesis is more common than is probably supposed. Lane[10] considered the malady in coal heavers a normal finding and stated that it was indeed common among the laboring classes.

Neugebauer,[11] who has given more attention to this subject than anyone else, thought the condition was produced by a thinning of the interarticular portions of the last lumbar vertebra as a result of improper development or fracture of this portion. Others have since shown that it can occur from fracture of the articular processes without the changes in the vertebra. Lane considered in some cases, at least, that the change in the interarticular portion is caused by excessive pressure. Goldthwait[12] has shown, however, that the condition can occur without any destruction in the interarticular portion. In such cases he states that because of the various shapes and facings of the superior articular processes of the first sacral segment, unlocking takes place, allowing the fifth lumbar vertebra to slip forward. It is not the marked forms of spondylolisthesis but the slighter forms, difficult or impossible to diagnose, which are to blame for some of the obscure continued postoperative backache.

Goldthwait also notes as a cause of some back pain, the variations in length and shape of the transverse processes of the fifth lumbar vertebra and that in the height of the superior aspects of the lateral portions of the sacrum. In some cases one of the processes is so long as to even join the sacrum. In this connection Goldthwait states that "if the process were fused to the sacrum there would, of course, be no motion at this point. If it were free the impinging of the end of this process against the top of the sacrum (often forming a true joint), or the posterior part of the ilium, would not only limit the motion, but also, if repeated, would result in sensitiveness at the point of contact."

Another cause for backache, particularly that seen in patients who have just got out of bed for the first time after a prolonged stay, is postoperative flat-foot.

It has been known for some time that an extended stay in bed will so weaken the muscles and ligaments of the leg as to produce the typical flat-foot. This is more common in those cases where extension of the leg from fracture, etc., has been maintained without adequate support to the ball of the foot. Ogilvy[13] in discussing the subject of weak feet states that it "may or may not be accompanied by painful symptoms in the feet. The symptoms are those of a tired, aching feeling, referred to the lumbar spine, and are noted after the patient has stood on the feet for some time." An increase in the amount of standing or walking will increase the pain Ogilvy[13] says, while rest always relieves the pain. Continuing, Ogilvy notes that "upon examination of the back alone, there is little evidence of the cause of the pain. The spine is freely movable. There is no spasm of muscle or any other sign of any inflammatory lesion, nor is there any tenderness on pressure, nor deformity. The cause of the trouble is, therefore, likely to be overlooked, unless the feet are thought of and an examination of them made. These, when examined, are found to be everted. When questioned, the patient admits that the feet tire easily, are sometimes painful, and that the pain at times extends up the leg. It is of the greatest importance to examine such feet with the patient standing, and it is of just as great importance to remember that flat feet are not necessary to account for the backache caused by foot strain." In giving the cause of backache, even though the feet are found defective, Ogilvy states that the "proper foot balance is lost and the body poise is so changed as to throw an excessive weight strain on the muscles and ligaments in the back, producing a dull, boring pain, which increases in severity as the patient continues to overstrain these structures in standing or walking. When the foot balance is corrected and the foot strain relieved, the backache is immediately cured."

In some cases after all the possible causes mentioned above have been eliminated and the condition still remains unexplained, it has been suggested by most of the writers on the subject that there must be some peculiarity in development which diminishes the stability of the lumbar and pelvic articulations.

Coccygodynia is associated with backache in these cases at times. Pain in and around the region of the coccyx is also noted independently of backache. The affection, peculiar to women, presents unmistakable clinical features, but so far as I know there is no definite pathologic condition. The symptom more often appears in married patients, particularly those who have borne children, although it occurs in unmarried females. I do not recall a single case where it developed in a postoperative male patient. A history of injury is given in most of the cases although in two very typical cases occurring in our patients, no such etiologic factor could be elicited. In each patient there was a definite neurasthenic basis upon which I could place the cause of the condition. The pain complained of was sharp shooting and was intensified on sitting up in bed, sudden rising, or during the act of defecation.

In the treatment of pure postoperative backache preventive measures are more important than the after cure, hence one will readily appreciate the value of a well-padded table which conforms as nearly as possible to the outline of the spinal column. When the patient returns to bed a roll placed under the back, frequent turnings and allowing the patient to move of his own accord will often aid in preventing a severe backache. In other cases the malady will occur no matter what efforts have been put forth to offset it. When it does appear, massage, alcohol rubs and heat may be applied with marked success. The lumbar spine should be supported with bed rolls, pillows, and other simple measures employed to take as much strain off the lumbar ligaments as possible. We are usually able to gain but a slight measure of relief from change of position, although it may also be tried. The patient must not be allowed to suffer from this condition during the first few days of his convalescence. Among the medicines used to give comfort to such patients none seem to give the relief that some form of opium combined with the salicylates will accomplish. Usually I employ codeine ½ to 1 grain with aspirin, 5 to 10 grains and repeat the codeine within one hour if the pain is not relieved at once. Warm plain water enemas to be retained as long as possible and hot fluids per mouth are also used in some cases with great measures of success. The bowels and bladder are kept empty during the active treatment. The urine is watched for sugar and general eliminative measures carried out.

When the symptom is produced by some gynecologic disorder, the condition is met as soon as practical by methods accepted by the best authorities for the individual disease.

The treatment given in individual cases depends upon the extent of the lesion producing the symptoms. In every case the important factor is the diagnosis and if the case presents unusual findings the orthopedist, the neurologist, or the internist should be asked in consultation and treatment carried out as directed by either of them.

For acute strain of the pelvic articulations adhesive strips two inches wide are placed from the anterior portion of the ilium on the one side to a similar position on the other side. The strips are overlapped and continued to be placed until the whole lumbosacral region is covered. A pad of felt over the sacral region will often be appreciated as a more or less subluxation of the sacrum occurs in these cases. Goldthwait and Osgood state that in relaxed pelvic articulations frequently there is not correct opposition in the bones, the malposition being a true backward displacement of the sacrum in its upper part. They would correct such a malady by "hyperextending the spine by means of firm pillows under the lumbar curve or having the patient lie face downward with only the legs and thighs supported upon the table and the head and shoulders upon another, the body hanging entirely unsupported between. In this position the weight of the body drags the spine forward, which favors the replacement of the sacrum." A plaster of Paris jacket is now applied while the patient is in this position. It may be advisable to place the patient upon the frame as shown in (Fig. 152, page 467) which will allow of more sacral pressure. A spica including both thighs may become necessary in order to hold the pelvic bones in place after they have once slipped back from the malposition due to the relaxation of the ligaments. Goldthwait and Osgood would keep such patients in bed four weeks, then allow them to be out with some sort of removable jacket which is to be worn three months longer. The jacket, the authors say, should fit well down over the trochanters and be made of stiffened leather or plaster of Paris and applied with the patient standing and the lumbar spine moderately extended.

In the relaxations without displacement (and these represent the largest number according to my own observation) the adhesive strapping of the back and the jacket stated above are entirely sufficient. At night, when the pain is particularly severe, supports in the form of a bed roll under the lumbar curve or under the side if the patient wants to lie in this position may be used.

The cases presenting symptoms due to tuberculosis, hypertrophic arthritis, trauma, lumbosacral disturbances, abnormal spinous processes, etc., are treated by immobilization or in some cases even operation then followed by immobilizing measures.

In the treatment of coccygodynia the same general measures as noted above may also be employed. Hot sitz-baths, massage, and efforts put forth to discard any movement which will in any way aggravate the condition, are to be employed. The treatment, however, is generally unsatisfactory. At times the coccyx has been removed even without relief. Lippens[14] recently advised the injection of 0.5 c.c. of 50 per cent solution of antipyrin in alcohol into the third and fourth sacral nerves. In carrying out the technic Lippens points out that the point of exit of the third sacral nerve is an inch outside of the crest of the sacrum and an inch below the posterior inferior spine of the ilium; that of the fourth sacral nerve is a fingerbreadth lower. The treatment is worthy of trial in intractable cases.

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CHAPTER XII

SHOCK

By Willard Bartlett, St. Louis, Mo.

An historical account of the theories concerning shock, according to Crile,[1] reads as follows:

"John Hunter, in 1784, was probably the first to describe shock.

"William Clowes, in 1568, Wieseman, in 1719, and Garengeot, in 1723, *recognized* shock, and attributed it to the presence of some foreign body in the wound or in the blood.

"Guthrie, in his work 'On Gunshot Wounds,' speaks of waiting 'until the alarm and shock have subsided,' and details a number of cases.

"James Little, in 1795, was the first writer to use the word shock in the sense it is now employed.

"Travers, in 1827, described a number of cases of shock, and believed that shock to the nervous system might cause death without reaction.

"J. A. Delcasse, in 1834, stated that the effects of violence were transmitted chiefly through the osseous system, whereby the living molecules were separated from each other, especially in the brain, spinal cord, and liver.

"Erichsen, in his treatise in 1864, considered shock in railroad and other accidents to be due to the 'sharp vibration that is transmitted through everything,'—the immediate lesion being, probably, of a molecular character."

We were brought nearer to the modern conception in 1870. "In 1870, Goltz made his classical experiments on the frog and concluded that the shock phenomena observed were due to the vasomotor paralysis caused by mechanical violence.

"In 1873, Lauder Brunton wrote a monograph on the subject, in which Goltz's theory was accepted. Hofmeister, in 1885, wrote that malnutrition of the heart, fatty degeneration, general weakness, and loss of blood were the chief factors concerned in the production of shock. Gross describes it as a depression of vital powers, suddenly induced by external injuries, and essentially dependent upon a loss of innervation.

"Agnew wrote that it is evident, from a clinical standpoint, that the determining causes of shock must reach that portion of the nervous system from which the heart and lungs receive their motor endowments, for the feeble action of these organs is one of the fi observed phenomena of shock." This last quotation from his book brings us close to Crile's own vasomotor theory.

A host of other writers have considered the subject in different ways and from different angles, there being up to the present time, no unanimity of opinion as to its exact mechanism. Perhaps the best summary of the subject which has appeared to date is a critical abstract by M. G. Seelig,[2] of St. Louis, on "The Nature of Shock." I shall proceed to quote very liberally from it, feeling that this author's experimental work and exhaustive literature study enable him to produce an authoritative summary of the subject.

"For nearly a century investigators and clinicians have been propounding theories and promulgating doctrines that definitely located the cause of shock in an aberration now of this function or organ, now of that. Without exception none of these various theories has stood the tests of searching criticism. It is rational to hope, therefore, that by passing the various older working hypotheses in review, we may at least partially comprehend why they have failed, and likewise orient ourselves in a suitable critical attitude regarding the strength and weakness of the new theory.

"How may we explain this constant change of front? On two grounds: In the first place a failure to recognize what was so clear to the elder Gross, namely, that 'shock is a rude unhinging of the entire machinery of life,' and that we must therefore proceed cautiously in attempting to locate the unhinging at the door of any one particular organ or function. Secondly, we find an explanation for the multiplicity of theories in the frequent misinterpretations of experimental data or in the drawing of unwarranted conclusions from properly collected data. For example, to take up the most common type of confirmed faulty reasoning, almost every investigator of shock develops his line of thought around the central point that low blood pressure signifies shock. And so indeed it does, but it has never been proved and should never be assumed that low blood pressure is the primary causative agency of shock."

"The needs of more specific criticism make it imperative to deal critically with the development of the more commonly accepted theories of shock, as we know them today. In order to do this we shall select for analysis the following prevalent doctrines regarding the causative factor in shock, which is stated variously to be:

"1. Vasomotor exhaustion and paralysis.

"2. Cardiac spasm and eventual failure.

"3. Inhibition of the functions of all the organs.

"4. Deficiency of carbon dioxide in the blood (acapnia).

"5. Morphologic changes and eventual partial or complete disintegration of the ganglion cells.

"The theory of vasomotor exhaustion as the essential cause of shock was established on what seemed at the time to be a firm basis by Crile. His argument is based on the facts that the essential phenomenon of shock is low blood pressure, and that since there is no demonstrable lesion in fatal cases, and no later effects in those that recover, we must assume exhaustion rather than structural lesions to be the cause of this fall.

"The vasomotor exhaustion theory has also been attacked directly by the physiologists, Porter, Henderson, and Lyon, and indirectly by numerous other investigators who bring forward theories of their own—Vale, Kinnaman, Schur, Weisel, Bainbridge, and Parkinson.

"Henderson believes that in shock 'the vasomotor center does its full duty almost to the last,' that failure of the circulation is due to the diminution of the volume of the blood, by transudation of its fluid out of the vessels into the tissues, and that there is no 'fatigue or inhibition or failure of any sort in the vasomotor center.'

"Seelig and Lyon, in two papers, contest the validity of the doctrine of exhaustion of the vasomotor centers. In their first paper they measured the outflow of blood from the femoral vein in a normal dog, before and after section of the sciatic nerve. After section of the nerve the outflow was more rapid, as was to be expected. This same experiment was performed on a dog in shock, and despite the shock the outflow was more rapid after section of the sciatic, even more rapid, proportionally, than in the normal dog, thus demonstrating that the vasomotor center was transmitting active tonic impulses through the sciatic, even in a state of profound shock. Moreover, by ophthalmoscopic examinations they determined that the arteries of the retina not only did not dilate, but rather that they actively contracted as the animal went into shock. As joint author in this work, it is only fair for me (Seelig) to state that Erlanger contests our reasoning as regards rate of outflow, and also that we should have proved, but did not, that the contraction of the retinal vessels is really an active, tonic contraction and not a passive one due to empty vessels. In a second paper, Seelig and Lyon attack the problem from a different point of view. They emphasize the fact that in normal animals stimulation of the central end of the cut vagus causes a rise of blood pressure, and that this rise occurs even when the animals are in the profoundest degree of shock. Furthermore, utilizing Porter's doctrine of percentage rise, they found that the rise was proportionally as high in profound shock as in the normal animal. In order to exclude all reflex effects on the heart, they cut both vagi and removed the right and left stellate ganglia; but even after these procedures, stimulation of the central end of the vagus was followed by a rise in pressure. These authors conclude from their experiments that the vasomotor centers are active in shock.

"Of these theories which account for the mechanism of shock, none has made a stronger appeal to the clinician than the doctrine that cardiac failure is the essential element in the obscure symptom-complex—a principle laid down most emphatically by Boise, although Howell also admits cardiac shock, as well as vascular shock. Boise, who bases his views largely on the experiments of Crile, Howell, and Porter, attempts to prove that as a result of excessive stimulation of the augmentor nerves of the heart (due to peripheral trauma) this organ is thrown into spasm; that, therefore, in shock there is increased systole, decreased diastole, lessened output of blood from the heart, and therefore low blood pressure. The lowered blood pressure in its turn leads to further decrease in the output, establishing, as it were, a vicious circle.

"The heart is compromised in shock, beyond a doubt, but cardiac inefficiency is certainly not the primary cause of shock.

"Meltzer, it was, who developed in his characteristically lucid fashion the doctrine of inhibition of functions as the underlying essential phenomenon in shock.

"Meltzer ventures the assumption that the 'various injuries which are capable of bringing on shock, do so by favoring the development of the inhibitory side of all the functions of the body.' This predominance of inhibition makes its appearance at first in those functions which are of less immediate importance to life, and are therefore, less insured by safeguards protecting their equilibrium. With increased injury, the inhibition also spreads to the more vital and better protected functions of the nervous system.

"Such a doctrine as this serves well as a physiological hypothesis, but to the clinical mind searching for light it is not very satisfying.

"The doctrine of acapnia, viz., that shock is due to a deficiency of carbon dioxide in the blood, was enunciated by Henderson within the past decade, and for a time stimulated much work and much criticism. Henderson argues that the traumata that induce shock cause rapid deep breathing (hyperpnea) as the result of pain or excitement. This rapid deep breathing in its turn causes an undue ventilation of the lungs, during which ventilation, carbon dioxide is rapidly swept out of the circulation. Furthermore, when viscera are exposed, in an ordinary laparotomy, carbon dioxide is exhaled from their surfaces, thus lessening the quantity of this gas in the blood. By blood gas analyses, Henderson claims to have proved this primary contention beyond a doubt. Now carbon dioxide is not, as it is so commonly regarded, merely a poisonous excretion.

"When there is a reduction of carbon dioxide in the blood, the walls of the veins relax, the pressure in them falls, blood accumulates in them, and only a small amount is transmitted to the heart. Constriction of the arteries may for a time maintain a fair blood pressure. At last the supply reaching the right auricles becomes so reduced that arterial pressure falls, the heart beat becomes quick, the output is small, and severe shock is established. Deficiency of carbon dioxide has another remarkable effect. When the deviation from normal is considerable there is a tendency for fluid to exude from the plasma into the tissues. The plasma therefore becomes concentrated and the total volume of blood diminished.

"The conclusion that acapnia does not suffice as a cause of shock therefore seems to be inevitable, even despite the large quantity of data so carefully collected by Henderson over so long a period of time."

In support of this negative conclusion, Seelig quotes the work of Erlanger, Short and himself. It has become apparent to him as to practically every other clinician interested in this subject, that our every-day observations in practical life make it seem unlikely.

In reviewing the "exhaustion hypothesis," Seelig writes: "This hypothesis assumes 'that animals that are especially capable of being shocked are those whose self-preservation is dependent upon special forms of motor activity; that motor activity is excited by adequate stimuli, through nerve tissue directly. Whatever may have been the origin of the motor mechanism and its adaptive response on stimulation, there is in each individual, at a given time, a limited amount of potential energy; that motor activity following each adequate stimulus diminishes the amount of this potential energy; that in any animal, a sufficient number and intensity of the stimuli leads inevitably to exhaustion or death; that when the motor activity takes the form of obvious work performed, such as running, the phenomenon expressing the depletion of the vital force is termed physical exhaustion; and that when the expenditure of the vital force is due to stimuli which lead to no obvious work performed, especially if the stimuli are strong and the expenditure of energy rapid, it is designated as shock.

"The essence of the doctrine lies in the belief that the brain cells are composed of labile compounds capable, when adequately stimulated, of converting their potential energy into kinetic. If this power to convert is unduly excited and the cells immediately fixed, stained, and studied microscopically, they show what seems to be a deep overstaining due to an overproduction of Nissl substance. If the excitation is continued, the cells stain much lighter and show an altered relation between cytoplasm and nucleus, as well as altered form; finally, if the excitation is continued further, the cells take practically no stain (loss of Nissl substance) and are altered in form up to the point of actual disruption (Crile).

"In order to controvert this conclusion, it is necessary to controvert his facts or to show faulty logic in his process of deduction. The facts as they stand are merely confirmations of similar facts made by such trustworthy workers as Hodge, Hertwig and his school, and Dolley. No one has brought forward concrete data in rebuttal.

"Crile is concentrated on demonstrating a practical method; and in his very attempt he seems to miss the point that he aims for. He admits, without so stating specifically, the qualitative similarity and quantitative differences of all afferent stimuli. He demonstrated that fear, trauma, activity, senility, and numerous other states induce brain cell changes exactly similar to those of shock.

"He thereby links shock with a conglomerate group of other entities all the while that he is striving to isolate it. Possibly the statement that he desires to isolate shock as an entity is a misstatement, but Crile's whole line of thought and his general conclusions warrant the belief that he is striving to determine the etiologic factor underlying shock as a definite symptom-complex.

"Crile may encounter no difficulty in showing that the condition of shock has a definite morphological representation in the ganglion cells of the cerebellum, but he frequently approaches dangerously near the border line of speculative metaphysical reasoning in his attempts to prove that these same morphological changes are the prime cause of shock. And thus the problem stands—still unsolved."

It is suggested that those especially interested in the study of the mechanism of shock, read Seelig's exhaustive and thoughtful collective abstract in its entirety, the foregoing being made up simply of extracts from it.

The uncertainty which surrounds the subject comes out still more clearly the farther one goes into the literature. As an example of this statement, read what no less an authority than Henderson[3] has recently promulgated.

"Shock, in the broad sense in which the term is often used, is not a single, clear-cut disorder, but a group of conditions which differ one from another fundamentally. However, owing to the fact that these various conditions resemble one another superficially, they are generally confused. The first problem is to define and distinguish each one."

Feeling that "shock" was too broad a term and that one might more clearly define his meaning in terms of blood pressure, Bartlett[4] endeavored at Erlanger's suggestion to ascertain by a direct method whether vasodilatation or vasoconstriction characterizes low blood pressure produced in the dog by trauma. To this end, salt solution under constant pressure was injected into medium sized arteries and the rate of inflow studied as the blood pressure fell in consequence of injury to the cerebrum, the extremities, and the abdominal viscera. After the first set of observations, the trauma was applied more or less continuously to the end of each experiment.

In some of these experiments, the femoral artery was selected. It was divided high and a cannula was placed in the distal end. In other experiments, the splenic artery was divided as near the aorta as possible, a cannula was inserted distally, and all the branches supplying the spleen were ligated, leaving only the large terminal branch which anastomoses with the coronary artery of the greater curvature.

As a result of this experimental work on ten animals, there can be no doubt of the fact that the rate of inflow in shock was faster than normally the case, the average increase being 36 per cent. It is concluded, therefore, that decreased vasomotor tone is an accompaniment of shock.

It occurred to Mann[5] that the study of shock was important, since, despite the enormous amount of work done on this subject, a critical review of the literature showed an astounding amount of contradictory experimental data and a great number of diverse conclusions based thereon. He feels that the use of the word "shock" should be avoided, and instead, an accurate and detailed description of the patient's condition should be given. If the term be used at all, it should be applied to the condition in which, without any grossly discernible hemorrhage having occurred, the amount of circulatory fluid is greatly diminished on account of the stagnation of the blood in the smaller veins and capillaries, or by exudation of the fluid and cellular elements of the blood from the same.

Engstad[6] believes that psychic and physical shock are correlated; that psychic shock may follow a very minor or major operation, be transitory in effect, or remain permanent and wreck the patient's life.

The various observations regarding the *treatment* of shock have been almost as divergent as the theories which were advanced to explain the causes and mechanism of it. Crile[7] states that "nitroglycerin, atropine, saline infusion, digitalis, alcohol, caffeine, camphor, ergotin, ether, strophanthus, etc., have so many individual, even contradictory, actions that it would seem that these drugs could not all be indicated in the same condition. In selecting one of these drugs in a case of shock or collapse, would it not first be necessary to know definitely to what the fall in the blood pressure is due? It is due to the exhaustion of the anatomic periphery (blood vessels); of the heart; of the vasomotor; of the cardiac center; or of the respiratory center; is it an exhaustion or a suspension of function, or has the blood plasma passed through the vessel walls? If it is due to exhaustion of one or more of these centers or organs, would stimulation relieve the exhaustion, or would an increased exhaustion follow the stimulation? *Would it be better to lash the tired horse or give it rest?*

"If not all the centers and organs are exhausted, would it be advantageous to stimulate those not affected while the exhausted ones rested? Would it be advantageous to restore the blood pressure, as far as possible, by use of harmless mechanical means?

"Are not the centers governing the circulation automatic, and are they not all automatically stimulated? And are they not all stimulated to the point of exhaustion before the final circulatory break-down occurs? As applied to the centers that are depressed, is it better to depend upon a drug stimulation, or upon automatic stimulation?"

Whatever one may think of Crile's explanation of the phenomena of shock, one can not fail to agree with the underlying principles of treatment as advanced by this gifted research worker and surgeon.

Shock may at times be anticipated and prevented by far-reaching and rational preoperative consideration of an individual patient's needs. It is often possible to improve a bad risk, merely by rest in bed and proper feeding, previous to the operation.

The condition of many a dehydrated person can be marvelously improved by the introduction of liberal amounts of water under the skin or into the rectum. Of course, no preliminary catharsis should be indulged in here.

It is an obvious though much neglected fact that a long and tedious cross-country or railway journey renders an already sick individual doubly unfit to bear the strain of a major surgical procedure before adequate time for rest has been allowed.

A preliminary blood transfusion, unless there be active hemorrhage from a vessel that can not be controlled, will accomplish wonders toward improving a patient's condition for operation and now that the procedure has become so common and the technic been so greatly simplified, one is surprised that it is not more often resorted to as a preoperative measure. (As early as 1905 Crile was experimenting along this line.)

The surgeon must individualize in many directions; for instance it is obviously unfair to the chronic alcoholic to send him to the operating table after having been deprived for several days of his customary stimulant. The same may safely be said of the morphine and other drug habitués.

A night's sleep must be assured to every patient who is going to be operated on the following morning. As a matter of course, morphine is our most reliable agent for this purpose. Should there, however, be contraindications to its use, an excellent substitute will be found in the rectal administration of potassium bromide (2 drams) and chloral hydrate (10 drams) in 8 ounces of water.

Prophylaxis on the operating table concerns itself first of all with body warmth. It is taken for granted that the temperature of the room should be about 80° F. Crile (personal demonstration) formerly used an operating table which was heated by water circulation, while Robb (personal demonstration) employed a much simpler and equally effective plan of accomplishing the same object; viz., he had a number of ordinary incandescent bulbs attached underneath the top of the table and turned them on or off at will.

Hemorrhage and shock have distinctly different physiologic effects although their clinical effects are often by no means easy to distinguish and may, of course, be mixed in the same individual. However this may be, it will be readily granted that accurate hemostasis, inasmuch as it tends to keep the patient in good condition, is in a way a preventive of shock.

While not an advocate of haste in operating, I still believe all observers will admit that the man who takes all of the patient's needs into consideration and gets through an operation quickly will, other things being equal, observe less shock in his clinic than will the man whose work entails long exposure. Still more important, perhaps, in this connection, are delicate manipulation, gentle retraction, and the "featheredged" dissection of Crile.

Nerve-blocking, even where general anesthesia is used, is undoubtedly one of the best methods of shock prevention at our command. One of the authors observed an intrascapulothoracic amputation done without blocking of the brachial plexus, by one of the most distinguished operators in America, with the result that the patient, apparently of a strong constitution, died the following night. A few weeks later, he witnessed a much less expert surgeon at his first attempt of this kind; but the brachial plexus had been blocked with cocaine and practically no shock at all followed.

Cushing long ago called our attention to the fact that the condition of shock persists as long as centrifugal, depressing influences are given off from a crushed and mangled extremity, the result of railway or other similar accident. He very rightly urges, therefore, the earliest and gentlest possible amputation as the most logical means of combating shock.

When a patient has returned from the operating room in shock, the first thing to be considered is the conservation of the external body heat, since cold extremities, one of the earliest manifestations of shock, indicate a derangement of the cerebral centers which preside over the distribution of heat. The use of blankets, electric warming pads, or the electric light cage are among the readiest means at our command for combating chilling surfaces. If the patient is conscious, hot stimulating drinks, such as tea, coffee, and soup should be administered often and in small quantities.

Opinions are divided as to the value of alcohol in this connection. The animal experiment of Crile would tend to show that the lowered blood pressure, characteristic of this condition, is by no means helped by alcohol, but is probably influenced in the opposite direction.

In shock, there is every evidence that arterial blood accumulates unduly in the large internal veins, leaving a deficient supply for the cerebral centers, and for the heart to contract upon, hence it would occur at once even to a beginner to lower the head (**Fig. 20**) and elevate the foot of the bed. Another move in the same direction is to bandage the extremities and put gentle compression on the abdomen, thereby aiding the return flow of blood out of the large veins into the arterial side of the circulatory system and helping to reestablish the disturbed balance in the blood pressure.

We have at our command, two drugs which act upon the musculature of the peripheral arterial vessels and thus aid in restoring blood pressure. They are adrenalin and pituitrin. The action of the former is exceedingly transient and should be thrown directly into a vein in order that the maximum efficiency of it may be realized. About 10 minims of a 1:1000 solution are best injected in the following manner: the needle of a hypodermic syringe filled with adrenalin solution is thrust into the lumen of a rubber tube which is carrying salt solution into a vein and thus, in a very simple manner, the drug in dilute form is carried into the circulatory system and rapidly diffused. Since the effect is so transient, the dose must be repeated every few minutes until a physiologic effect is apparent, though the systolic pressure must not go over 100 says Corbett. Pituitrin is thought by many to have a more sustained and perhaps a generally more satisfactory action. It is given by intramuscular injection. Each original package as put out by the manufacturer, contains one to two doses.

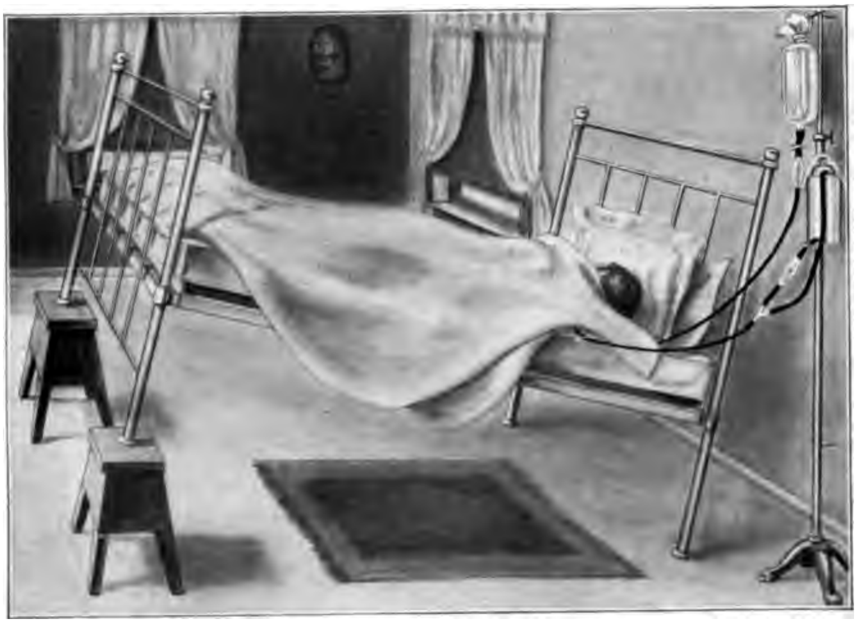

Fig. 20.—The patient's head is lowered in order that blood may gravitate to the cerebral centers and the heart. Water is given continuously under the skin and into the rectum.

Subcutaneous injection of salt solution or, as I think better, of sterile water, is generally advocated in these cases, although it is hardly reasonable to consider this one of the most important factors in treatment.

Crile informs me in a recent personal communication that he considers blood transfusion the best remedy which we possess for shock. While this position has as yet not been generally accepted, still we can not lightly pass over any contribution to the surgery of the vascular system which emanates from this source of so much experimental, as well as clinical, knowledge.

The general rules for the use of sedatives apply here as well as elsewhere. They are of undoubted value only inasmuch as they interfere with the perception of the various stimuli which may, in the aggregate, add to the general state of depression.

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CHAPTER XIII

HEMORRHAGE

By Willard Bartlett, St. Louis, Mo.

Postoperative hemorrhage is one of the most distressing accidents that may complicate the after-treatment of a surgical patient. This is particularly true, if it be the result of an oversight or neglect on the operator's part, and the rapidity with which it sometimes overwhelms the unhappy patient, leaves no time for remedial measures.

Hemorrhage may be defined in a number of ways; viz., Concealed, Open, and Mixed. The first two are self-explanatory, while by "Mixed Hemorrhage," is meant that variety in which the bleeding is primarily within a body cavity or wound defect, and approaches the open type when the blood follows a drain or tampon to the surface. Hemorrhage may, of course, be arterial, venous or capillary, if one has the source of it in mind when the definition is formulated, and when classifying according to its causation, it may be due to surgical trauma, pressure decubitus, to erosions of various sorts, to the progress of a dyscrasia, changing the blood itself, or to a general pathologic process affecting the vessel walls. Perhaps the most generally useful classification of hemorrhage, from the viewpoint of the operator, is one which takes into consideration the time of onset, hence arise the terms *Primary, Reactionary,* (*Matas*[1]), and *Secondary.*

Primary hemorrhage, as the name indicates, begins at the time of operation and continues after the patient is put to bed. A striking example of it is seen in the recital of the following case which came under my observation: An attempt was made to ligate the innominate artery for aneurysm of that vessel. The surgeon had just sawed through the clavicle and was trying to elevate it, when a torrent of blood gushed out. An effort to control the hemorrhage was made with gauze packs and pressure, but the loss continued during the thirty minutes that the patient lived after the accident. The clavicle was found, at autopsy, to have formed a portion of the wall of the aneurysm, and to have been considerably eroded. This is an example, not only of primary, but also of external, arterial, and pathologic hemorrhage, as well. From this it may be seen that no one classification serves to completely define the type of hemorrhage in many instances.

A very well-known type of primary hemorrhage is seen after the division of kidney parenchyma for any purpose which entails operating on the pelvis. No matter how accurately the defect is sutured, blood almost invariably finds its way down the ureter, and as it passes in the form of a clot, characteristic colic is experienced.

A form of primary hemorrhage, pathologic in nature, was seen by us a few years ago when an operator made an extensive incision into a myelogenic carcinoma situated in the upper end of the humerus. He was unable to control the bleeding which continued for days, and until the patient was exsanguinated.

I know of another instance in which a crucial incision was made through an enormous carbuncle and well into the surrounding edematous tissues of the neck. The patient never ceased to bleed until his death some twenty hours later. This was another form of pathologic primary hemorrhage.

A primary hemorrhage of the type due to dyscrasia was seen after a common duct operation on a highly jaundiced patient. Every stitch hole, as well as the incision itself, continued to ooze from the time they were made until a blood transfusion was done.

The study of *reactionary hemorrhage* (loosely termed "delayed hemorrhage"), is a source of the keenest interest to the operator, since this type, more frequently than the primary or secondary varieties, is directly under his control and may, in many instances, be prevented if proper care and foresight are exercised.

During the time that the patient is regaining consciousness he frequently increases the blood pressure as a direct result of restlessness, and in consequence, forces blood out of the tiny vessels which had been clamped but not tied, because they remained dry while the patient was perfectly quiet. Many a hematoma, infected or otherwise, will be noted at the first dressing by the operator who does not ligate every vessel during the early stages of an operative procedure.

Again reactionary hemorrhage, sometimes of alarming extent, is the variety which comes after the use of spring clamps for the temporary control of the blood vessels during operations on the hollow abdominal viscera. This can be most readily proved by stomach lavage after any gastroenterostomy. Reactionary hemorrhage may become a matter of the gravest importance in an instance like the following one which I observed: About two hours after a thyroidectomy, the surgeon was summoned to the operating room, to find his patient suffocating and the neck enormously distended. The stitches were removed, a large blood clot rapidly evacuated, and one of the ima vessels from which a ligature had slipped, quickly secured.

Secondary hemorrhage comes at a time remote by several days at least, from the date of the operation and is common after the separation of a slough in many situations, and resulted in a high mortality during Percy's earlier work with the cautery in cancer of the cervix. He soon found it advisable to ligate both internal iliac arteries as a prophylactic measure. This form of hemorrhage, slight in extent, is perhaps most commonly seen now in the separation of the sloughs, which result from the prevalent use of the clamp and cautery operations for hemorrhoids.

A secondary hemorrhage, as a result of erosion, was exceedingly common in the preantiseptic days when hospital gangrene was so greatly dreaded. The authors observed a classical example of it in a patient whose lower jaw had to be removed for carcinoma. He commenced to bleed almost two weeks later from the branches of the external carotid artery; infected material had found its way out of the mouth down into the planes of the neck, and erosion of these large vessels taken place. This man's life was saved by the ligation of his common carotid artery, a procedure which we find has been successful in two-thirds of the cases in which it has been attempted.

I have noted an instance of secondary hemorrhage from pressure decubitus of the iliac vessels, in consequence of a rubber drain tube being improperly placed and left too long in the abdomen after an operation for acute suppurative appendicitis. A very common pathologic cause of secondary hemorrhage is arteriosclerosis. The early history of ligation for aneurysm of large vessels is replete with instances in which a fatal termination ensued upon the ligature cutting through rigid vessel walls. Secondary hemorrhage was seen when a heavy ligature cut through liver substance five days after the removal of a tumor from the lower border of that organ. The patient was so reduced that she succumbed later to the effects of anemia.

The amount of blood in the human body has been variously estimated by early writers to be from 1/20 up to 1/5 of the body weight. Most authors of recent times, however, have agreed with Howell[2] and with Stewart[3] in the statement that 1/13 of the body weight consisted of blood. This matter can hardly be considered definitely settled, if one agrees with Crile,[4] who writes: "It must be concluded that with our present knowledge the question is still under judgment. The very nature of the problem makes it a difficult one to solve, and at the best the statement that the ratio between the total blood mass and the body weight is a constant one must be considered to be only very roughly approximating the truth."

It would prove a matter of vital importance to the surgeon to know just what percentage of a patient's blood might be lost and the patient still survive. Of course, circumstances alter cases; especially is this true regarding *rapidity* with which blood is lost, hence, no general definite statement can be made as to the exact amount which may be lost without causing the death of the individual. Still, most authorities agree with Howell that 3 per cent of the body weight may be lost in blood and the patient recover. Matas states that the loss of one-half the individual's blood will certainly cause his death. A very illuminating statement along this line may be quoted from Tillmans[5] who writes that, "After severe loss of blood every surgeon has seen in a relatively short time—two to three days—threatening symptoms vanish in cases where he expected certain death; and again, on the other hand, some patients go into collapse after the loss of very little blood. Very young children may be endangered by an insignificant hemorrhage, and weakly children a year old have died after the loss of only 250 gm. of blood. In strong adults, who are otherwise healthy, the loss of half the total amount of blood is sure to be fatal. Women appear to stand the loss of blood better than men. The formation of new blood seems to take place more easily and rapidly in them on account of the periodic replacement of the blood lost in every menstruation (Landois). Fat people and old and weak individuals are very susceptible to the loss of blood. The more rapidly the hemorrhage takes place the more dangerous it is."

After performing forty-seven animal experiments for hemorrhage and operating a large number of patients affected by it, Crile wrote: "In all varieties of hemorrhage from normal animals there is an immediate tendency to a compensatory or natural recovery. Granting the truth of this statement, the question at once arises as to just what a 'compensatory recovery' is. In other words, what do we mean when we say that 'compensation' occurs in the course of a hemorrhage?

"Compensation may be defined as being the natural effort of the circulatory system to maintain a normal or at least efficient blood pressure after diminution of the efficient vascular content. The phrase 'efficient vascular content' is used advisedly for the reason of stasis in the vascular trunks.

"Roughly speaking, compensation is noted in all the grades of hemorrhage until such a degree has been reached that the vasomotor center is no longer actively responsive to reflex stimulation, such as burning a paw or stimulating the sciatic nerve. With the hemorrhage and the fall in the blood pressure the specific gravity of the blood falls. After the hemorrhage has proceeded until there is no effort at compensation the animal unaided rarely recovers. If the blood pressure is raised either by saline infusion, by bandaging, or by the administration of adrenalin, sometimes the centers become more active, and the blood pressure assumes and holds a higher level.

"In experiments in which the hemorrhage was continued until there was no spontaneous compensation, and there was no response to reflex stimulation, the animal could rarely be made to recover. There was a marked difference in the final result if an interval intervened between the time of the ending of the hemorrhage and the beginning of treatment. *The longer the interval of low blood pressure the less marked were the effects of treatment.* In rapid bleeding the blood pressure continues to fall after the cessation of the hemorrhage. The extent of the recovery depends upon the individuality of the animal and amount of the hemorrhage. The proportion of lost blood to the body weight that animals withstood and recovered from varied considerably in individual cases. This degree of variation seemed to us to be greater than is usually given. In some animals recovery occurred when three-fifths of the estimated blood had been lost, while in others death would occur after a loss of two-fifths. It was impossible to estimate in any given animal with any degree of accuracy the proportion of blood to its body weight which it might lose and recover.

"What, then, are the secondary factors entering into the fall in the blood pressure and its recovery? It may be assumed that the primary factor is anemia with consequent lessening of the immediate nutrition of the active physiologic mechanism for the maintenance of the normal blood pressure. Among the secondary factors we may assume that the action of the vasomotor center stands first."

Not only do the important nerve centers suffer impairment of function as a cause of acute anemia, but all authorities agree that cardiac activity is satisfactory only as long as there is a sufficient volume of fluid within the auricles and ventricles. The restoration of the blood after hemorrhage was studied by Kiefer,[6] who found that the red corpuscles were restored in number more quickly than was the percentage of hemoglobin. Bierfreund[7] found the regeneration of the blood to commence within five to twenty days after the rather insufficient loss which is attendant upon the average surgical operation.

Von Mikulicz[8] studied regeneration after the loss of large amounts of blood and found compensation to be as follows:

1. Less than 1 per cent of the blood mass in two to five days.

2. From 1 to 3 per cent of the blood mass in five to fourteen days.
3. From 3 to 4 per cent of the blood mass in fourteen to thirty days.

Diagnosis.—The *diagnosis* of an open hemorrhage or one of mixed type where blood follows a drain to the surface, needs, of course, no extensive comment. It becomes quite a difficult matter when the diagnostician is confronted by a patient who appears to be failing rapidly after a difficult and prolonged surgical procedure; then the problem of differential diagnosis between shock and concealed hemorrhage becomes difficult, or as many of our most experienced writers agree, well nigh impossible. One instance in my experience shows how difficult it may be to differentiate between postoperative hemorrhage and perforation of a hollow abdominal viscus:

An exclusion of the pyloric region, together with a gastroenterostomy had been done for ulcer. A few days later, the patient rather suddenly entered a state of seeming collapse, while complaining of severe pain in the epigastrium. I naturally feared that a stomach suture line had given way, hence, reopened the abdomen immediately, only to find the upper intestinal coils full of blood. Fortunately, in this instance, conservative treatment resulted in the patient's recovery, while the painful incident demonstrates very well one of the possibilities of error in the diagnosis of concealed hemorrhage.

Almost in line with this case was a remark which I once heard W. J. Mayo make, as a part of one of those delightful and instructive clinical talks which he is accustomed to make in the operating room. He was discoursing on shock, and surprised us all by stating, in his cryptic way, that he had usually found the abdomen full of blood at autopsy on patients who had died of shock following an abdominal operation. This points in no unmistakable way to the relative frequency of the two conditions.

Matas very well summarizes the leading features in symptomatology, when he tells us that the picture varies directly with the amount of blood lost, the rate at which it escapes, and with its location. As a matter of course, the symptoms to be immediately detailed will be more impressive, the larger the hemorrhage, or more rapid the flow, while the symptoms attending the escape of a given amount of blood into an elastic space, like the peritoneal cavity, are much less alarming than those which attend the rapid accumulation of the same amount in the fascial planes of the neck, which enclose the trachea, as happened a few hours after one of my goiter operations previously mentioned.

The effects of acute anemia make themselves known in several ways. The heart muscle gets a decreased amount of blood through the coronary vessels, hence, is unable to functionate in the normal manner. The respiratory center is stimulated by the lack of oxygen and we see the expression of increased respiratory action, which is termed "air hunger."

The psychic manifestations of cerebral anemia are anxiety and restlessness. All the while the leucocyte count may be said to rise steadily in a typical case. It might be thought from the foregoing that a diagnosis of concealed hemorrhage is a matter of mathematical certainty. On the contrary, I have seen, at least, one fatal instance in which the patient was perfectly free from restlessness and "air hunger" up to the time of dissolution.

The picture of hemorrhage is not complete without mention at least of posthemorrhagic anemia and its consequences. It has, however, no features which distinguish it from chronic secondary anemia in general, hence, no space will be devoted to it here.

The treatment of hemorrhage must begin with preventive measures. The finding of a high blood pressure puts one on guard and may limit the extent of a surgical procedure that would seem indicated under the circumstances. If the clotting time of a patient's blood is found to be longer than eight minutes, the surgeon should be on the alert for a dyscrasia, which might allow a comparatively simple operation to assume formidable proportions, because the blood refused to clot in the normal way. Hemostasis is favored by the position of a patient on the operating table. This was vividly impressed upon me while a student in Europe. Lexer, who was then assisting in the Royal Clinic, was engaged in the removal of a Gasserian ganglion and was greatly annoyed by venous oozing. His chief, Prof. Von Bergmann, entered the operating room by chance, and suggested that he complete the operation with the patient in the sitting posture. From that time until the close of the operation, the field remained singularly dry, and the illustration was never forgotten.

The prophylactic use of pressure on large arterial trunks during amputations, goes back to the Dark Ages of surgery, while the use of constriction, for example, Esmarch's bandage, in this connection is too well known to need more than passsing mention.

Treatment.—The treatment of actual hemorrhage is logically divided by Matas into three phases. (1) The arresting of the hemorrhage; (2) the prevention of a recurrence; (3) the recovery of the patient. The actual arrest of bleeding is accomplished in quite a variety of well-known ways. The application of a clamp and a ligature represents the ideal, where this is possible. A gauze tampon, the application of heat or other cauterizing agents, such as hot water, steam, or a chemical escharotic, to say nothing of extreme cold, may accomplish the desired purpose. Guided by physiologic considerations Sir Victor Horsley checked the bleeding from small vessels by placing tiny strips of detached muscle upon them, thus liberating a fibrin ferment. Among the less well-known local means of arresting hemorrhage must be mentioned Kocher's coagulin, of which we read widely differing opinions. Hess[7] made extensive use of free omental grafts in the control of hemorrhage in injured abdominal parenchymatous organs. One can readily see the advantage of suturing omental grafts around a spleen, as was done by Dr. Kirchner of St. Louis. As a substitute for a gauze pack, which is often difficult and dangerous to remove, Yaeger and Wolgamuth devised a web of a substance similar to catgut, derived from the sheep's intestine, which they successfully packed into bleeding cavities. The absorbability of this mass naturally commends it to our attention.

Hess proposes a new local application for the control of bleeding. Regarding it, I shall quote directly from his conclusions.

"Tissue juice made from brain (thromboplastin solution) has proved itself of practical value in controlling hemorrhage wherever it can reach the site of bleeding. * * * It is to be recommended for local use in the parenchymatous bleeding associated with various operations, etc. Where local applications fail, it should be injected into the site of hemorrhage, as in bleeding from the gums following tooth extraction. * * * It is innocuous when given by mouth in considerable dosage, and would seem to be indicated in bleeding from the stomach and from the upper intestine."

A number of general means for arresting hemorrhage have been proposed and used with varying degrees of success. Lansberg claims good results for an extract of corpus luteum, while Weinstein reports marked success in twelve cases following hypodermic injections of one-half grain emetine hydrochloride. Schreiber made intravenous injections of 200 c.c. of a 5 to 20 per cent solution of grape sugar, and claims to have checked severe gastric and intestinal hemorrhage by so doing.

One to two per cent of gelatin dissolved in salt solution has been rather extensively used as an intravenous injection. However, opinions differ as to its efficacy. The prevention of recurrence of hemorrhage is, perhaps, best illustrated by referring the reader back to an illustration of hemorrhage due to the erosion of a large vessel.

After a patient has been almost exsanguinated by repeated hemorrhage from a branch of the external carotid, we not only succeeded

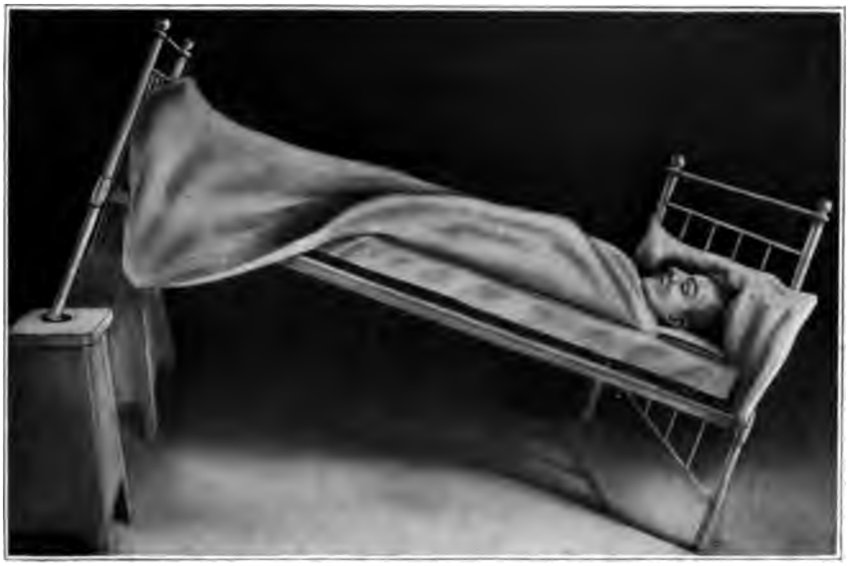

Fig. 21-A.—The simplest means of increasing the amount of blood in the heart and central nervous system.

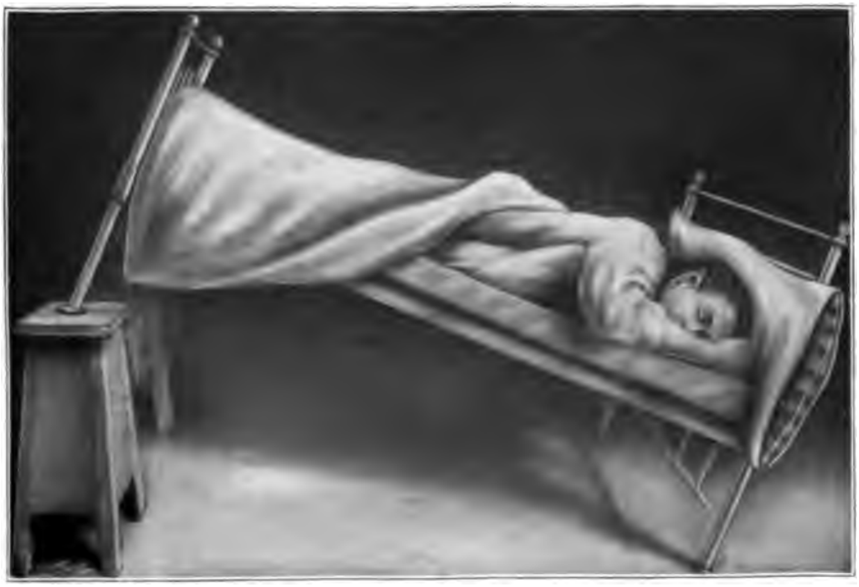

Fig. 21-B.—A posture suggested for shock and hemorrhage where the respiratory apparatus is full of mucus.

in stopping the bleeding, but prevented any renewal of it by ligating the common carotid artery.

One of the most logical and efficient methods at our command in accomplishing this is blood transfusion, which so alters the composition of the patient's blood as to render a recurrence much less likely. It goes without saying that this object is attained by keeping the patient quiet, for which purpose morphine is invaluable. The means which conduce to the recovery of the patient are legion, and most of them exceedingly well known. The relatively little blood that remains in the circulatory system must be sent, first of all, to the central nervous system and the heart, hence, we employ posture (Fig. 21A) and a compression of large veins as has been fully described under the treatment of shock, which see.

The same considerations of heat, stimulants, etc., obtain here, as in the chapter just mentioned, therefore, a repetition is avoided at this time.

In acute hemorrhage, the volume of fluid in the circulatory system must, of course, be augmented as early as possible. This must be done with the greatest caution, however, unless the source of bleeding is known to have been controlled. Water under the skin or into the rectum is of undoubted value, unless the hemorrhage has been of excessive amount. Under such circumstances, blood transfusion is the only remedy at our command which will save the patient's life. The technic of these procedures has been fully discussed in special chapters on Hypodermoclysis, Proctoclysis, and Transfusion.

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CHAPTER XIV

DILATATION OF THE HEART WITH REFERENCE TO POSTOPERATIVE ACUTE DILATATION

By Willard Bartlett and Riley M. Waller, St. Louis, Mo.

The best informed members of the medical profession consider the existence of acute postoperative cardiac dilatation a question which is still open for debate. If one does not admit such an entity, how are those cases which show soon after operation all the classical signs, both clinically and at autopsy, to be classed?

The occurrence of such a condition after abdominal operations is reported to be as low as 2 per cent, or even less, in some clinics, with a much higher percentage in others. Wertheim[1] in five hundred consecutive hysterectomies for cancer had ninety-three deaths, twenty-nine of these being due to acute dilatation alone.

Before proceeding further, one must bear in mind some of the characteristics and physiologic factors peculiar to the heart. It has been found that surgical procedures on it have met with varied success—from uneventful operation and recovery on the one hand, to serious sudden changes in action or even stopping in a similar operation. Bad results can often be avoided if the procedure be gradual, because the heart can stand considerable trauma and handling if done by degrees.[2]

Heart muscle is a tissue, and a highly specialized one, hence it is subject to fatigue, toxins, chemicals, etc., perhaps to a greater extent than some less specialized ones. When one recalls that the force the heart developes is dependent on the amount of blood coming into it, also that the force is in a geometric ratio[3] to the intake, it is only reasonable to believe that the heart is fatigued when those changes occur.

Having recalled these facts, it would seem logical to consider the causes of acute dilatation: 1. Previous diseases and conditions are known by all to affect the myocardium to a greater or lesser extent, and to operate in the presence of such cardiopathic conditions is not without risk. Often the surgeon must decide between the dangers of the surgical condition at hand and that of operative procedure in face of a weakened myocardium. Blackford, Willis, and Haines,[4] working at the Mayo Clinic, have found that (a) a large percentage of cardiopaths, often thought hopeless, could be relieved by surgical intervention; (b) that most surgeons tend to have too great a balance of cardiac safety on their side to be of greatest value to their patients. This would seem quite optimistic, but those findings apply only to select cases. This immediately brings up the question of a standard for these "selected cases." It must also be remembered that the facilities for handling such cases are not so good as would be desired in many clinics.

2. Turning now to the factors that may affect either a weakened or a clinically normal heart, the first to be considered is the Trendelenburg position. It has long been known that the extreme of this position tends to raise the blood pressure. The explanation of this is that the blood leaves a large splanchnic area and the heart must respond more forcibly and faster to distribute the blood. Gatch, Gann, and Mann[5] found experimentally that if dogs, in which artificial respiration is used, were deprived of this, the heart would stop beating. Those in the extreme Trendelenburg position stopped in two and three-fourths, four and one-half, three and one-half, and four and three-fourths minutes, respectively, while those in the horizontal position stopped in nine, six and one-half, and eight minutes. It was also found that these dogs could readily be revived by massaging the heart through the abdominal wall. These same hearts, after resting, were again treated in the manner described above and ceased to act in less than two minutes. Instead of giving long, forceful beats, as in the first trial, they showed rapid, incomplete contractions, and a very dilated heart, thereby, indicating that such hearts had been seriously damaged by the first procedure.

3. The same authors[5] also found that when animals struggled while under light anesthesia, the hearts showed a great ballooning in all four chambers. They soon became overdilated and ceased to act. Such results are similar to those observed by Ray and Adami[6] in 1888 in which it was shown that increase in abdominal pressure by compression increased the heart's output 29.6 per cent. One can also imagine the effect of tight abdominal packing with gauze and of struggling during the operation.

4. In case of a severe hemorrhage or shock, where the heart muscle is quite anemic, large transfusions or injections of fluids given rapidly would increase the heart's output tremendously and cause the partially degenerated fibers to dilate. Occasionally such accidents happen during these procedures.

5. Crile[3] suggests that increased pulmonary pressure due to forced artificial respiration causes considerable difficulty and embarrassment for the right heart in forcing blood through such an impacted organ. Such a condition is certainly analagous to the described condition of hypertrophy secondary to emphysema. In addition, this process is more sudden and violent, hence more serious than when due to emphysema.

6. Finally Vander Veer[7] presents a theory backed up by case reports to explain the condition in some patients at least. In a series of postoperative chronic cholecystitis and appendicitis in elderly persons it was found that in a small percentage of these all the signs of acute dilatation developed thirty to sixty-five hours after operation. Rosenau believes that there is a specific streptococcus in those organs that has an affinity for the myocardium, and claims to have found such. They suggest culturing the contents of such organs at operation and preparation of stock vaccines. This work is not conclusive, and further experimentation is being done.

According to onset, the condition may be designated as early and late. The symptomatology in both is practically identical. (a) Early—this includes those individuals that soon die after transfusion and injections of fluids and those weakened by disease. These fail to rally after operation and show pulse of 130 or more, which is weak and irregular. They are restless, have no courage, grow worse, and often die before thirty-six hours. (b) Late—this group includes those that have apparently stood the shock and strain of the operation splendidly, but after eighteen to sixty hours do poorly. They begin to show, after pulse has already come down to 100 or less, a rapid increase of twenty or more, and all the signs of dilatation. Decompensation may take•place and the case probably end fatally. Before one makes a diagnosis it is well to rule out the following that might simulate it: hemorrhage, atropine, right-sided hypertension, dilatation of the stomach, or rapid absorption of toxins from a draining wound.

Pathology.—Grossly such hearts are often brownish in color. The walls are thin and flabby and show an increase in dimensions of the heart chambers. Microscopically the picture may be identical with that found in dilatation following a break in compensation in a previously hypertrophied heart. As to the details one may find one or more of the pathologic conditions seen in myocardial involvement elsewhere. In other cases there are found degenerated fibers in a heart that has not previously been hypertrophied or diseased over any length of time. Fragmentation has never been described.

Diagnosis.—It is of utmost importance that the surgeon recognize the condition at once and differentiate between shock, cerebral anemia, toxic absorption, drugs, etc. The treatment is diametrically opposed to that of shock and cerebral anemia, hence the need of diagnosis. In shock, one does not find the cardiac area enlarged, neither does the condition manifest itself, as a rule, except at operation or very soon after. Cerebral anemia would be present after many of the conditions that produce acute dilatation. One would also expect to find more marked mental and nervous symptoms. From toxins and drugs one usually has the records and reports as guides for such action.

Treatment.—The basis of all treatment is to relieve the heart of as much strain as possible by decreasing its volume output and to improve the condition of the myocardium. The following principles are suggested because they are distinctly indicated.

1. Of greatest importance is prevention as expressed by thorough preoperative physical examination and, after having once begun the operation, to keep in mind the factors that are responsible for injury to the heart.

2. The horizontal, or better, the Fowler position tends to dilate the large splanchnic area, thereby decreasing the volume output of the heart.

3. Massage in hearts that are about to stop or have done so may be a life-saving measure, if applied properly to the lower anterior border of the ribs directing the force upward and inward to the heart.

4. Bleeding if done here effects one of the few conditions in modern practice that is favorable for such intervention. This offers a quick direct means of relieving the load on the heart. The amount to be drawn is much a matter of judgment in the individual case.

5. Cardiac stimulants, (a) digitalis in massive doses, (b) aconite 3 ♏ at a dose until desired effects on the pulse are obtained, or (c) strophanthus 8 ♏ at a dose may be given to slow and to strengthen the pulse.

6. Absolute bed rest is to be enforced. Opiates are to be used in large enough doses to keep patient quiet. The nurse must feed, bathe, and attend to all the patient's personal needs until out of danger. No visitors or unnecessary disturbances of any kind are to be allowed.

7. Withholding of fluids and mild stimulation and elimination would tend to reduce the volume of the blood and for that reason are indicated.

8. Diet. Soft low protein diet during the acute stage would be the choice. Food in concentrated form is much preferable to the more bulky ones in that they require less energy for absorption and propulsion.

Summary.—(1) Acute postoperative dilatation is a condition that is often preventable, and can be brought about by one or more recognized factors. (2) That accurate diagnosis and treatment is necessary and essential at the earliest possible moment for the best interests of the patient.

Full credit is due Riley M. Waller for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER XV

ACUTE DILATATION OF THE STOMACH

By O. F. McKittrick, St. Louis, Mo.

This condition has long been considered a definite clinical entity by many writers on the subject. As early as 1853, Miller and Humley[1] reported a case dying from such a malady. The autopsy revealed an unusually distended stomach, the small intestines being contracted and free from any disease. A few years later others reported cases in which the phenomenon was noted. In 1859, Brinton[2] reported more cases and described the disease. Even at that date, it is recorded that the affection is one "exclusively concerned with the stomach." In 1873, Fagge[3] discussed the symptoms at length and first advised lavage as the only efficient remedy. Since this date, many cases have been reported.

It was not until 1892, the condition was really recognized as an important postoperative complication.[4] Three years later, Schnitzler[5] suggested the postural treatment in addition to lavage. In 1907, Conner[6] reviewed the whole subject in detail, and he particularly influenced the surgeons in this country to pay more attention to the condition so that since this time, considerable thought has been given to the accident. Among the more important contributors to the literature may be mentioned Laffer,[7] Chavannaz,[8] Müller,[9] and Payer.[10] In 1913, the malady was again subjected to a critical discussion by Ruth[11] and Borchgrevink.[12] Another valuable paper was added in 1914 by Linke[13] and the work of Lee[14] brings the discussion of the subject up to the present time.

The condition occurs far more frequently than had been observed in the past. It was formerly stated by Smith[15] that acute dilatation was never reported under twenty hours after the operation. Payer soon after Smith's declaration, was able to definitely determine by examination of the stomach during narcosis, that a distinct atony occurred in nearly every one of the three hundred patients whom he studied and that dilatation immediately followed their awakening from the anesthesia. Furthermore, he found that the paresis did not subside for from twelve to fourteen days after the surgical interference. Of the 144 cases reported by Borchgrevink, (137 of which were collected from the literature since 1895) 66.2 per cent occurred after operations. On the other hand, Laffer's review of the literature, which includes those cases before 1895, gives only 38.2 per cent as postoperative.

The nature of the operation which particularly predisposes to this malady, is laparotomy. Of Borchgrevink's collection 78.8 per cent, and of Laffer's 69 per cent occurred after opening of the abdomen for work upon the female genital organs. These constitute the largest number, which is closely followed by surgical procedures involving the biliary systems. Next in order come the appendix, and then operations upon the stomach itself. Acute dilatation after the last named most frequently followed gastrojejunostomy.

Of the extra peritoneal operations, those upon the kidney lead, with the extremities following next in order. Herniotomies and curettages, and even operations upon the face, have been complicated by this malady.

The cases studied by these observers were, with one exception, all subjected to a general narcosis, ether being the anesthetic most commonly used. The kind of anesthetic seemed to have no influence, however. Lichtenstein[16] states that the condition may even occur in patients who were not given a general anesthetic.

As to the *time* dilatation appears in surgical patients, Ruth, Lee, and others have shown that it may occur during the operation. Lee in his paper, reported a case in which death occurred on the operating table, due to this phenomena. He also included five other cases in which the malady was observed, but happily did not terminate fatally.

The symptoms usually commence before the third day. The largest number of recorded cases occurred between the second and third days. The cases occurring within the first twenty-four hours can hardly be estimated, since vomiting due to the narcosis, so often masks the symptoms that the condition is not recognized. Cases have been recorded much later than the third day. Chavannaz reported it occurring during the sixth, Mayo Robson,[17] the tenth, and Nakahara[18] the sixteenth postoperative days. In Borchgrevink's case, symptoms did not appear until the twenty-fourth day after operation. Others have reported the malady occurring as late as the thirtieth postoperative day.

Cases appearing later than ten days after an operation are usually associated with some intercurrent infection, and should, we think, hardly be included as a postoperative complication. The complication most generally occurs in thin, weak and poorly nourished individuals, and especially in those who present a general enteroptosis.[19]

In 130 of the cases in which sex is mentioned, 60 per cent occurred in women. The most common age was between thirty and forty years. The youngest patient was a boy of four, and the oldest, a woman sixty-five years old.

Many theories have been put forth to explain the *cause* of this complication. Individual predisposition has been considered by some to have considerable influence. Payer, Chavannaz, and Linke, have all reported successive operations upon the same patient, in support of this view. We would regard such a theory, as Lee, who says it is too indefinite to be considered seriously.

Many predisposing factors which favor the condition must be thought of under such circumstances. Among these may be mentioned the various forms of nervous and digestive disturbances, which in themselves have been described as inciting causes. Gastroptosis, enteroptosis, and even hyperchlorhydria,[30] have also been considered as causative agents.

Kivin[20] and Arcangeli[21] attribute the cause to a functional disturbance of the suprarenals, with lack of adrenaline, which regulates the nervous control of the stomach.

One of the most generally accepted theories is that paralysis of the stomach is due to disturbed innervation. It was first considered a possible cause by Brinton, in 1859, and his ideas, more or less modified, have maintained themselves throughout the years. In 1907, great impetus was given this theory by the work of Braun and Seidel.[22] By experimentally influencing the nervous system, an atony of the stomach may be produced, also lesions of the nervous system deprive the stomach of the ability to empty itself. This failure of the gastric musculature therefore is a functional disturbance.[13] Linke and others believe that without continued failure of the musculature of the stomach, dilatation is impossible.

In addition to those mentioned, Riedel states that the handling and exposure of the organ during abdominal operations, is one cause of the muscular paresis. Von Herff and Kelling[23] showed that in a series of three hundred inhalation narcosis, the great majority of the patients developed some grade of gastric atony and dilatation. Von Herff[24] attributes this to poisoning of the neuromuscular mechanism by the anesthetic. If this persists longer, the postanesthetic paresis will also persist, and dilatation of the stomach is naturally predisposed. Linke adds that the paralysis of the gastric musculature may be due to central or reflex, as well as peripheral disturbances of innervation. Such may be brought about by mechanical injury as Riedel already mentioned, or by toxic influences upon the muscle fibers, or infection of same or by both, or even by a disturbance of the internal secretion governing it, as was pointed out by Kivin, and also by Arcangeli.

Kundrat,[25] in 1891, states that the primary cause of acute dilatation, was compression of the duodenum by the mesentery as a special form of high strangulation. Nine years later, Müller called attention to the similarity of symptoms in cases of high intestinal obstruction and those of acute dilatation of the stomach.

Others have considered paralysis of the stomach as the primary cause, and the occlusion of the duodenum a purely mechanical secondary incidence. This is brought about either by the weight of the stomach on the duodenum as it crosses the spine,[26] or else by a secondary arteriomesenteric compression, brought about indirectly by the distended stomach's pressure on the small intestine.[12]

Most recent literature supports the swallowing of air, in addition, to the paralysis theory, as the most likely cause of this malady. Lee, particularly, thinks this most probable. The five cases which he collected, and the one of his own, certainly bear out his contention that the rapid dilatation of the stomach, upon the operating table, could hardly have been due to anything but gas distention. In his own case, the gas may have arisen from food fermentation. It is well known that a certain amount of gas is normally present in the stomach; to this gas may be added that from the duodenum, that resulting from the swallowing of ether, or that formed by the excretion of it into the stomach, during an ether narcosis.

The position of the patient, in addition to the anesthesia, more or less hinders the escape of the gas through the cardia. But despite these various ways in which gas may collect in the stomach, it is highly improbable that a sufficient amount can be formed to cause rapid dilatation, as was seen in Lee's cases, unless the patient actually swallows *air*. Many observers claim to have noticed the patient accomplish this feat during anesthesia. The stimulation of the salivary glands produces an increased flow of saliva, thereby causing the patient to swallow more frequently, the air being carried with the saliva and mucus into the stomach. In aerophagics, the symptoms are considered most marked,[4] and many observers claim the aerophagia as the most important etiologic factor. Among them may be mentioned Tissier,[27] Couto,[28] Buchholz,[29] and Lee.

The cases of acute dilatation of the stomach which come to *autopsy* always present the organ more or less distended, sometimes only slightly, and at times this viscus is so inflated that it reaches the symphysis. In such instance, the walls are extremely thin, showing the contents within. It usually has a bluish color, and at times small ulcers or erosions can be found in the mucous membrane, from which the bleeding comes which is seen frequently in these cases.

The small intestines are usually collapsed, and lie in the pelvis. The duodenum is occasionally distended, however, but usually in its upper part only.

In cases in which gallstones are discovered, adhesions are often present between gall bladder and duodenum. The older writers considered these important as a primary cause for the distention. The arteriomesenteric compression above noted is mentioned by a few authors as one of the autopsy findings. It was found by Payer, Conner, Box and Wallace, and others.

The *outcome* in these cases was formerly almost always fatal. Conner's statistics, which were published in 1907, showed a mortality of 72.5 per cent. Laffer, who reported his statistics in 1908, showed a decrease to 63.5 per cent. Borchgrevink's in 1913, gave only 54.1 per cent. This latter statistician showed that the death rate is only 26.2 per cent in the cases reported since 1907. He does not include the patients which were treated by surgical operation, stating that the mortality under such circumstances was 100 per cent.

The length of time in which death supervened, was from several hours, to sixteen days after the first symptom. Usually it occurs within two days. If the patient lives this long, the chances for getting well are 50 per cent better. Of 31 untreated cases of acute postoperative dilatation collected by Borchgrevink, (some received medicine), 29 died; 2 alone escaping. One was treated with apomorphine, and the other given hypodermoclysis.[12]

The *symptoms* depend upon the seriousness of the case, and the condition in which the patient was before the dilatation occurred. The purest *form* occurs after a less serious operation, before which the patient has felt fairly well.

Usually the first sign of any trouble is a feeling of fullness in the epigastrium, associated with an uneasiness which quickly develops into actual pain. This grows more and more intense, depending upon the extent of the dilatation. Patients have screamed with pain, day and night, others have moaned continually, while in rare instances, very little or no pain was complained of.

With the beginning of the distention in the upper abdomen, the pulse quickens, and the face becomes anxious. Hiccough may now occur. Some patients become dizzy, while all complain of thirst which continues with increasing severity, the longer the malady lasts.

Vomiting now commences. It occurs at frequent intervals, and is usually free of the retching seen in ordinary vomiting; a portion of the contents of the stomach comes up without much strain or effort, the fluid suddenly filling the patient's mouth, which he empties. If the stomach tube is now inserted, more fluid will be obtained than the amount which the patient has vomited. The amount vomited at a time is usually not very great, 6 to 12 ounces, probably, but the tube will bring up, at times, large quantities of fluid, aggregating occasionally six or more liters. The secretion quickly reforms. Morris[30] considers the increased secretion of the gastric mucosa a very important point in the disease. The vomiting persists throughout the time the stomach is dilated, ending usually a few hours before death. In some instances, no vomiting occurs. Such cases while indeed remarkable, are not rare. The outcome is probably less favorable in the absence of this symptom.

The *contents* of the stomach consists of gas, mixed with a yellowish or greenish odorless watery fluid. In the operative cases discussed by Lee, an odorless gas alone was noted. As the vomiting continues over several hours, it becomes brownish, and finally black from the admixture of blood. It now grows offensive, presenting a nauseating, sweetish smell. In addition to the blood, bile is present, This, seemingly, is a constant finding. Fluid which does not show blood, will contain bile. Hydrochloric acid is very much diminished in many cases, and at times, lactic acid may be associated with it. Various bacteria have been found in sporadic cases, but the nature of the disease will largely determine the stomach contents, particularly if the primary disease be in this organ.

The quantity of fluid secreted during such a condition is large, as already stated. The stomach dilates rapidly, and the capacity is enormously increased within a very short time. A normal stomach may expand, so as to reach the pubis within twenty-four to forty-eight hours.[4] Such a phenomenon may even transpire within a very few hours.[19] Usually, there is not a symmetrical distention of the abdomen, and the outlines of the gas in the stomach can be seen or determined by percussion. Further examination of the abdomen will reveal tenderness, particularly in the epigastrium, which reaches its maximum during the early stages of the dilatation. Succussion or splashing sounds are elicited, and, at times, peristalsis may be seen. The tumor-like mass disappears on inserting the stomach tube.

Symptoms.—The general condition of the patient remains comparatively good, despite the constant vomiting. The chief symptoms, according to Borchgrevink, are the abdominal distress caused by the actual stretching of the musculature, and the continual thirst. The urine is scanty. Cyanosis may occur. In the severe cases, or even in the milder cases, which have been progressing nicely, there may suddenly occur symptoms of collapse, followed in a few moments by death. Such early symptoms do not occur frequently, but as a rule, a few hours will intervene, even in the worse cases, before such an end results. In the meantime, the pulse becomes thready, fast, and easily compressible; the blood pressure falls, the eyes become sunken, the skin cold and clammy, with other attendant symptoms of shock. A few instances have been reported, in which the first symptoms were those of collapse.

The intestines, in many instances, continue with their normal functions, but a more common observation is that all passing of flatus and bowel movements cease. Diarrhea has been recorded accompanying the dilatation of the stomach.

Treatment.—The treatment consists first of all in preventing too free catharsis in weak, debilitated patients, before they come to the operation. During the surgical procedure the possibility of this complication must not be ignored, and in patients in whom the malady is likely to occur, all preparations must be made beforehand for a timely lavage. At the end of every stomach or gall bladder operation, the stomach should be washed with plain cold tap water, in order to clear out any gas or fluid which may have accumulated during the narcosis. In many instances, our patient is sent back to bed with the tube in place, and the stomach washed every two or three hours with cold water, until all nausea and vomiting cease.

When the condition occurs on the operating table, lavage will quickly and surely relieve it. Such a measure has not in itself been so successful in the convalescing patient. Where the tube alone was used, 50 per cent of the cases reported by Borchgrevink died.

The essential treatment then, includes not alone this effective measure of keeping the stomach free of gas and fluid by frequent washings, but a constant *changing* of the position must be carried out. The most comfortable posture for the patient is on the abdomen. A pillow under the chest will make him more comfortable. After he has lain this way for an hour, he is changed to his right side, and at the end of another hour, to the left side, and then on the abdomen or back, as most desired by the sufferer.

The thirst is controlled by giving continuous proctoclysis of plain tap water, which is made into a 5 per cent glucose solution. Also continuous hypodermoclysis of physiologic salt solution, or plain, freshly distilled, sterile water instead of salt solution, may be employed.

Under no circumstances, give anything by mouth. Ice held in the mouth, and all water, spat out, or a little mineral oil will keep the mouth from becoming too dry and parched, and will in great measure, assist in allaying the thirst. Every case showing symptoms and signs of this very common condition, must at once be energetically treated, with infinite care for details regarding the comfort and well being of the patient.

When the viscus has returned to the normal dimensions and position, the abstinence from food or drink per mouth should be continued for several hours longer, as everyone with experience knows that even the smallest amount of any fluid may initiate symptoms again.

As to the drugs which may be used, probably intramuscular or intravenous pituitrin is the most efficacious.

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CHAPTER XVI

POSTOPERATIVE ILEUS

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Sir Fredrick Treves[1] wrote, late in the last century, that two thousand people die every year in England of intestinal obstruction. More striking is the recent statement of Roser, that four thousand deaths occur every year in Germany, from this same cause.

Ileus had been known, and was recognized even earlier in the history of medicine, but it was not until the end of the seventeenth century, that its anatomic characteristics were cleared up. We have been accustomed to define it as a malady characterized by certain cardinal symptoms; however, most surgeons will agree with Wilms[2] that it is better to call this disease a serious disturbance of the intestinal motor function, in view of the fact that one or more of the cardinal symptoms are not always present early in the malady.

It is difficult to treat this as an entity, since it may be defined in so many different ways, for instance, it is seen in an acute form, which presents characteristics, wholly different from those of the chronic recurring variety. It may be *immediate,* that is, appearing within a few days after an operation, or the onset may be *several years* later.

Mortality.—The mortality in the postoperative variety of ileus varies somewhat with different authors, but may be roughly stated as being about 50 per cent, where reoperation has been undertaken after a lapse of several days; whereas it has been a little less than one-half this distressing figure, in consequence of timely interference. These figures constitute a résumé of statistics by Deaver and Ross,[3] Coley,[4] Naunyn,[5] Pilcher,[6] Ruge,[7] Brown,[8] and Kirchner.[9]

Pseudoileus.—Before proceeding to a consideration of true postoperative intestinal obstruction, it seems best to consider separately, the temporary paresis of the intestinal tract, which is so frequently seen following abdominal operations, which varies considerably in different instances, and was long ago given the name pseudoileus, by Olshausen.[10] This condition is to be clearly differentiated from true obstruction, although it must be admitted that it may run the entire gamut of severity, from simple distention, to paralytic ileus itself. It is exceedingly common, and in its simplest form, follows the rough handling, prolonged exposure, and undue cooling of the abdominal viscera. There are individuals, so constituted nervously, as to seem particularly susceptible to it.

Symptoms.—The symptoms of this condition are distention, and inability to pass gas, with or without the rhythmical so-called gas pains, often nausea, and vomiting. The patient is restless, anxious, and frequently difficult to control. The condition may simulate true intestinal obstruction, but may be often distinguished from the latter by a consideration of all the circumstances which obtained previous to, and at, the operation.

Prognosis.—The prognosis is ordinarily good, varying, of course, with the intelligence and discrimination displayed in the treatment, and the condition may usually be considered rather disturbing than dangerous. No doubt spontaneous recurrence takes place in very many neglected instances. Where death results from any cause whatsoever, no morbid anatomic condition can be demonstrated, so far as the intestinal tract is concerned. It must be added, that the same thing is true of certain types of true ileus, to be immediately described, thence the reader will see how difficult it is to always make a hard and fast distinction between pseudoileus and the true condition.

Treatment.—The treatment of the condition begins with prophylaxis, the principal point in this connection being the proper use, or perhaps better, the nonuse, of drastic purgatives, just before operation, says Schübert. The condition, we believe, is seen distinctly less frequently after the use of enemas than after castor oil, immediately before operation. We realize perfectly well, that there are conditions which demand prolonged and thorough catharsis, but the routine use of these drugs, prior to operating, is often as senseless as is failure to individualize anywhere else, in medicine. After pseudoileus has commenced it is frequently not a simple matter to overcome it by the use of cathartics by mouth, since they are vomited almost as soon as given. It is perhaps better to use highly stimulating enemas of a volume so small that they do not add to the patient's distention. In this connection, we have found enemas of pure glycerin in doses of one to two ounces, to be most efficient in starting peristalsis. The same may be said of six ounces of freshly prepared milk of asafetide, as enema—the last-named drug has a marked influence in quieting the patient as well. A rectal tube, left in place for a long time, seems to greatly aid some individuals in passing gas. As a matter of course, stomach lavage will relieve distention, and thus minimize embarrassment of circulation, as well as of respiration.

It can not be too highly recommended for patients who have a diaphragm markedly pushed upward. A patient who has resisted every therapeutic measure intended for the relief of gas, will often point the way to his own salvation by begging to get out of bed onto the commode. We were greatly surprised, in early years, to see such patients freely expel feces in sitting posture, after they had seemed wholly unable to do so in bed. Physostigmine in the large dose of $\frac{1}{25}$ of a grain, hypodermically, has proved of the greatest value in my hands, while more recently, pituitrin has been strongly advocated in this connection.

Classification of True Ileus.—There are a number of possible classifications, though probably none of them are wholly satisfactory. The one which we shall follow seems to make the subject understandable and is a combination of those that have seemed to us most logical.

I. *Dynamic (Functional) Ileus*
  (a) Paralytic.
  (b) Spastic.
  (c) Hirschsprung's disease.
  (d) Thrombosis and embolism of mesenteric vessels.
II. *Mechanical Ileus*
  (a) Strangulation.
  (b) Obduration.
  (c) Volvulus, knots.
  (d) Caused by Meckel's diverticulum.
  (e) Kinking.
  (f) Strictures.

A brief analysis of the various forms of (I) dynamic ileus, is perhaps in order: the *paralytic* variety occurs most frequently by far, in consequence of peritonitis. It also follows pressure upon or squeezing of intestinal coils at operation. Its origin is more obscure, when it follows degenerative conditions of the central nervous system, or is seen as a reflex manifestation of acute pancreatitis, hematoma at the root of the mesentery, twisting of an abdominal organ or turn on its pedicle, biliary obstruction, rupture of a solid abdominal viscus, fracture of spine or pelvis, or retroperitoneal suppuration. It is common enough, after urine, bile, or blood has collected in the peritoneal cavity, and sometimes accompanies intestinal ulceration. It may be added, that paralytic ileus can indirectly complicate diseases of any abdominal organ.

The *spastic* form of dynamic ileus, has been noted most frequently in hysterical individuals. Wilms saw it in a tabetic patient, while

Murphy encountered it in a man suffering from lead colic. It has appeared in those afflicted with intestinal worms, and has followed Littré's hernia, not infrequently. *Hirschsprung's* disease is marked by a most obstinate retention of intestinal contents in the enormously distended colon. The extent of bowel affected, varies greatly in different individuals.

Thrombosis and *embolism* of the *mesenteric vessels* though comparatively rare following surgical operations is nevertheless one of the most serious complications with which we have to deal.

Virchow[20] in 1847 apparently was the first to describe occlusion of the mesenteric vessels. His work aroused little interest and it was not until 1875 that the clinical picture was adequately described by Litten.[21] Investigations which were now begun in earnest resulted in valuable contributions being made to the literature by Cohnheim, Cohn, Oswald,[22] Corner,[23] Falkenberg[24] and others. Until 1902, 64 cases of thrombosis were recorded, 49 of these being arterial. Since this time Jackson, Porter, and Quinby[25] have collected 214 cases, and given an extensive review of the subject. Recently Laplace,[26] Killiani, Woolsey, Greensburg and Parker Syms, have each reported cases suffering from this disease. Sym's case was ready for dismissal from the hospital when this complication developed, ending fatally within a few hours. This affection, according to Corner, is most common, in men past middle life in whom mitral disease is present, though endocarditis equally plays an important part. Arterial thrombosis is most apt to follow operations in those cases associated with arteriosclerosis, endocarditis or atheroma of the aorta, while venous thrombosis usually occurs primary or secondary to thrombosis of the portal veins.

As to the relative frequency, Corner further states that the arteries are five times more liable to be involved than the veins and that the superior mesenteric artery was found at autopsy to be thrombosed 40 times, where the inferior mesenteric was involved once.

Occlusion of the vessels of the intestines produces a hemorrhagic infarct in the greatest majority of cases. Depending upon the duration of the complication, a simple hyperemia with superficial necrosis may occur, or an absolute gangrene of the intestines with perforation and localized peritonitis with pus formation may be presented. In the most fulminating type, gangrene may occur within forty-eight hours. In other cases this may not be present for several weeks. In most cases fluid will be found at autopsy in the peritoneal cavity while the mesentery swollen and edematous, will contain hemorrhages of various sizes between its layers, and there may be marked enlargement of the mesenteric glands.

Under II, mechanical ileus, let us consider first, very briefly, the various causes of *strangulation.* Coils of intestine sometimes become caught after operations, through openings in the omentum, mesentery, mesocolon, or broad ligaments. Pathologic strands and bands of all sorts, form frequently, giving rise to a similar accident. Next come the hernias, inguinal, femoral, umbilical, and incisional, to say nothing of the rarer examples, such as those into the obturator opening, and the foramen of Winslow.

Obturation implies a plugging of the bowel lumen, in almost any way. We have seen this occur twice following the forming of a fecal stone, twice as the result of an enormous gallstone sloughing directly out of the gallbladder into the bowel, and once, when a gauze pad that had been left in the abdomen, found its way into the intestine. Others have seen it when due to an accumulation of intestinal worms.

Obturation may be due to any tumor of the intestinal wall, but particularly to one attached by a small pedicle. There are forms of external pressure upon the intestine, which are difficult to classify, but which perhaps most nearly approximate obturation. The various forms of intussusception may all be considered under this head. We saw one unusual case of this kind, in which a small cancer at the end of Meckel's diverticulum, caused a complete invagination of this appendage, and acted as the head of the column, down the colon.

Volvulus is most common in the small intestine. It can rather easily occur to a sigmoid with a long mesentery, while a volvulus of the ileus-cecal region, with complete obstruction, was seen and successfully treated in my own hands, by anastomosing the head of the cecum to the sigmoid.

Meckel's diverticulum may interrupt the function of the intestine in a variety of ways. I have seen it tied in a knot around a loop of small bowel. It may become adherent and kink the bowel at its attachment. It is rather subject to diverticulitis, and can also cause an intussusception.

Kinking of the intestine is one of the commonest forms of obstruction. This usually results from adhesions, and is now less common than in earlier times, when the peritonization of stumps and pedicles was given less consideration than is now the case.

Strictures are prone to produce a chronic recurring form of ileus. They follow ulcerative conditions, but are much more frequent during the growth of a carcinoma.

Of course, any variety of ileus may attack the patient who has been operated upon, just as it may the individual who is in perfect health, but certain types of obstruction have been a direct consequence of intraabdominal operations, thence I shall devote especial attention to them, while adhering to the general classification of the subject. The dynamic form of the disease (I) is very much more common after operation, because peritonitis of some extent is so very frequently encountered. I have seen instances, too numerous to mention, as is unfortunately true of all operators. Paralysis of the bowel occurs where the nutrient blood vessels have been injured at operation: it has followed removal of mesentery tumors, and affected the transverse colon after resections of the stomach, during which the vessels in the mesocolon were damaged.

Under II, mechanical form, *strangulation* is common in certain situations. Small bowel rather frequently slipped through an opening in the transverse mesocolon, in the early days of stomach surgery, before we learned to suture this membrane closely around the site of a posterior gastroenterostomy. Numerous strangulations, resulting in death, are on record. The same is true of the internal Alexander operation, and of uterine suspension, in both of which operations, a patulous ring has been left by some operators. After intestinal resection, the wedge-shaped defect in the mesentery has not always been sutured, and the same accident has resulted.

Obturation ileus has been less frequent perhaps, as a postoperative complication. I know of one instance, in which a laparotomy pad of large size was left in a peritoneal cavity, with immediate resulting obstruction, due no doubt to pressure and something akin to obturation, while a true case of this kind has been cited above, in connection with a gauze pad, which found its way into the gut.

Volvulus produces postoperative obstruction most commonly, as a recurrence after unsatisfactory operations for this very condition.

Meckel's diverticulum is perhaps uncommonly the cause of this condition during a surgical convalescence.

Kinking of the bowel, and obstruction has been most frequent at a remote period after the formation of adhesions to improperly covered stumps in the pelvis. I know of one instance in which a complete obstruction persisted for years after the sigmoid became attached in this manner. Fortunately the condition was completely relieved by a secondary operation. Too extensive inversion of an appendix stump is known to have resulted in kinking at the ileocecal junction, with such interference as to necessitate a remote secondary operation. The rather modern procedure of removing the gall bladder has been responsible for the duodenum becoming adherent in the defect, so that chronic pyloric obstruction has resulted, in many instances. We have more than once been driven to secondary gastroenterostomy for the treatment of this condition.

Strictures, while uncommon as a cause of postoperative ileus, may be seen after careless suturing, and the production of too broad a diaphragm in the making of an end to end intestinal anastomosis. The very nature of the human bowel makes this accident unlikely, still it is somewhat difficult to avoid in experimental work on the dog. This animal possesses a gut which is exceedingly thick walled in relation to its diameter. Perhaps the most familiar example of remote postoperative ileus, due to stricture, is the variety which follows secondary jejunal ulcer, after gastroenterostomy. It is partial in nature, and is, no doubt, to some extent, the result of spasm.

Symptoms and Diagnosis.—The four cardinal symptoms of ileus are inability to move the bowel or pass gas, colicky abdominal pain, feculent vomiting, and meteorism. This presupposes a typical outspoken case. The patient is anxious, restless, and in evident distress, as a rule. The rate of pulse and respiration are increased, the face is pinched and dusky, while in the later stages, the extremities are cold, and the abdomen likely to be boardlike and tender. This superficial description of the disease holds good for any late case, no matter whether it belongs originally to the dynamic or to the mechanical variety, since obstruction can not remain complete for any length of time without the intestinal wall becoming pervious to germs, which ultimately produce a peritonitis, thus adding the element of paralysis to the already existing condition. Hence it comes about that a late diagnosis between dynamic and mechanical ileus is impossible. In an early case it should be possible for a trained observer to differentiate between the two.

A diagnosis of functional ileus will, in any case, be greatly facilitated by an exact history and a knowledge of all the circumstances which attended the original operation. It may be said, in general, that there is diffused pain, fever, constipation, an abdomen that is tender all over, and *uniformly* distended. There is general muscular hypertension. The vomiting, which characterized this condition, has long been termed "slopping over," from the fact that it has little projecting force. It is almost incessant, the greenish feculent fluid escaping a mouthful at a time. Pain, of an excruciating degree, has been noted in those cases of dynamic ileus which we have seen caused by interference with intestinal blood supply. So striking has been this manifestation in rare instances, as to lead to an accurate diagnosis.

In early mechanical obstruction, no matter what the exact cause, certain fairly characteristic phenomena are to be noted. The pain is more localized, and definitely cramplike. The tenderness is also confined, while the distention is limited to intestinal coils, which in a thin-walled abdomen, can be readily outlined, and peristaltic waves be quite as readily seen. The muscles are absolutely boardlike, while the vomiting has a projectile quality, which may carry it to a considerable distance. Large quantities are emitted at a time, with evident effort of a distressing nature.

The diagnosis of the exact anatomic form of mechanical obstruction must be very rare. One point, not to be forgotten in this connection, is that chronic recurring obstruction, especially in an elderly individual, frequently spells cancerous stricture of the large bowel. The subject of diagnosis can not be dismissed without one caution, namely, time should never be wasted in trying to do more than establish a mere differential diagnosis between the dynamic and the mechanical forms of the malady, since the treatment of the two is essentially different. It must be borne in mind that the patient looks to his medical adviser for the speediest possible treatment in this condition, rather than for a completely satisfactory diagnosis.

Mechanism and Cause of Symptoms.—We must confess to a rather meager knowledge of the finer details of ileus. We do not know at all, how the reflex forms of the dynamic variety are connected with the original lesion, in a given case; indeed, the inflammatory variety, the one most frequently seen, is not wholly clear to us, since we have no means of telling whether toxic agents directly affect intestinal musculature, or accomplish the same thing indirectly through the sympathetic nerve supply.

Murphy and Vincent,[12] after a series of experiments, conclude, in agreement with many other investigators, that the acute symptoms are caused by the toxic substance, which they found in the obstructed loops. Very interesting suggestions as to the cause of death in these instances, have emanated from McLean,[13] who is not satisfied with the toxin theory; but noting, as he does, a marked loss of weight during the illness, believes death due simply to dehydration, which occurs as a consequence of the persistent and copious vomiting. He substantiates his position by the observation that an obstructed animal which is given saline infusions lives much longer than the control animal which is not so treated.

Treatment.—In the treatment of true ileus, as opposed to the somewhat indefinite pseudoileus considered above, one must distinguish sharply between the dynamic (functional), and the mechanical varieties, since the entire conception of the two is as different as are the causes. We shall take up the *dynamic* form first, and reserve the mechanical for separate consideration. As above stated, dynamic ileus results, in the majority of instances, from peritonitis, which under the conditions of modern surgery, is encountered, of course, at the original operation, and not caused by it. In this connection, the prophylactic plan of Andrus[14] attracts attention. This author, after draining a peritonitis case, in which ileus might readily supervene, attaches a distended loop of bowel to the edge of his incision, and drains it primarily, thus accomplishing in advance, a measure which might later be demanded as life saving. Where postoperative dynamic ileus already exists, the indication is a perfectly definite one, namely, to treat the cause, and in most instances, the ileus will take care of itself, this means that a peritonitis, if localized, must be treated by drainage under local anesthesia, of course, since the intestinal paresis of general anesthesia can only add fuel to the fire. Peritonitis of a mild degree, or one in which no localization is possible, is nowadays universally treated by the Ochsner method, namely, by placing the bowel at absolute rest, with morphine, and thus preventing dissemination. The indication here is clean cut, in that the peritonitis must be treated, rather than the bowels moved. This distinction is, however, not always made, and the tired horse is whipped when he ought to be rested, so to speak. It is not only futile, but little short of a crime to attempt purgation in these cases. By so doing, one succeeds only in embarrassing the overloaded stomach and upper intestinal tract. The chief physiologic need here is for water, since not only is none absorbed from the stomach walls, but hypersecretion from the upper digestive tract rapidly dehydrates the patient. As long as he ''slops over,'' lavage must be practiced every two or three hours, and his ever-increasing thirst be assuaged by water in the rectum and under the skin.

We must not content ourselves with the above-mentioned treatment any length of time in the presence of increasingly severe symptoms, but after a few hours employ the one sovereign remedy at our command, that is, a fecal fistula. This is, of course, always done under local anesthesia, and may in many instances be advantageously combined with drainage of the peritoneal cavity. I think all of us must agree with Thompson,[15] that resection has no place in the surgery of dynamic ileus, when caused by peritonitis, which again reminds us of the importance of sharply differentiating between the two cardinal forms of this malady. When a segment of intestine is paralyzed, in consequence of damage to its blood supply, the patient's life can be saved in only one way, that is, by resection. In one instance, I successfully operated, early in thrombophlebitis of the mesenteric vessels, where there was beginning gangrene of two yards of small intestine.

Mechanical ileus, in any of its many forms, demands treatment of a mechanical nature. Wilms, in the most exhaustive treatise ever written on this subject, feels that the prophylaxis consists largely in the prevention of visceral agglutinations and adhesions. There must then be no cooling or drying of areas which it is necessary to handle and expose. Sepsis and limited necrosis must be prevented, and the use of tampons restricted to the minimum, all peritoneal rings are most carefully to be sutured, and exposed surfaces to be painstakingly covered by peritoneum. Very early, gentle catharsis will accomplish wonders towards the prevention of adhesion to damaged visceral surfaces. Reicheldoerfer[16] voices an ingenious suggestion, which may be of value: he gets his patients into a sitting posture as early as possible after abdominal operations, feeling that adhesions which may form, will do less than the usual harm, by holding the patient's viscera in the position to which they are accustomed while he is up and employed. Keilty[17] reminds us that we were on the wrong track, years ago, when we filled the peritoneal cavity with oils and other foreign substances in the hope of preventing adhesions during the reparative period.

Given a patient suffering from mechanical obstruction, there are two procedures possible, both of them operative; one, drainage of the embarrassed bowel, and the other removal of the cause. The choice of procedure is taken out of a surgeon's hands by finding nutritional changes in the intestinal wall. He has then no recourse but resection of the affected area. In the absence of this anatomic change, the general condition of the patient will always be his guide as to whether he shall do a drainage operation or proceed to radical treatment of one of the many definite conditions which may bring about this form of ileus.

If an artificial anus is decided upon, it should, of course, be made as low down as possible in the obstructed area, however, it will be done only on a very sick patient, hence the first distended coil that presents itself is usually thankfully chosen by the operator. The cecum is by all means to be elected, if the obstruction be low enough, since attachment of it to the abdominal parietes is not at all likely to cause future kinking. This choice has the further advantage of leaving the midline and left side free for a secondary attack upon the obstructing cause. I have made extensive use of lateral intestinal anastomosis as a substitute for fecal fistula, with most gratifying results, in dangerously sick patients where the obstruction was high enough to reveal "flat," as well as distended, intestinal coils. This is done under local anesthesia, with the utmost ease, and is from the patient's viewpoint, vastly preferable to a disgusting fistula, but is, of course, not to be undertaken when there is blood in the peritoneal cavity, or where other evidence of a nutritional disturbance is present. This procedure is further recommended by the well-known physiologic consideration that a lateral intestinal opening drains only as long as obstruction persists; thence we have every reason to believe that function is often reestablished in any intestinal segment thus temporarily excluded.

No matter what operation is undertaken, the anesthesia is a matter of the greatest importance. The intestinal drainage can, of course, be done under local anesthesia, but it will be insufficient if the abdomen is to be explored and a radical maneuver executed. A matter of greatest importance is stomach lavage, just before, and during a general anesthesia, since many a patient is drowned in his own vomit, early in the administration of a general anesthetic, in careless hands.

The degree of evisceration, while searching for the cause of obstruction, is fully appreciated only by the surgeon who has learned, through bitter experience, to appreciate the narrow margin of resistance possessed by obstructed patients. It is furthermore an unnecessary maneuver, since the entire small bowel can readily be investigated, by replacing it, a little at a time, as it is withdrawn. This pre-supposes a knowledge of the direction in which one is working, but this can be readily acquired by thrusting the hand down to the root of the mesentery, which is disposed almost parallel to the spinal column, and remembering that the current of an attached intestinal loop follows the up and down direction of the mesenteric root.

After one has found the obstruction, he may be aided in his decision upon radical measures, by recollecting that von Mikulicz,[18] the master of intestinal surgery, experienced a mortality of 40 per cent, in resection of obstructed colon, but did the same operation in the interval, with only 10 per cent loss. It is a much disputed matter, as to whether one is justified in emptying the intestine on the operating table. No doubt it is theoretically desirable that we rid the patient of toxic material, still one is surely not warranted in the use of any complicated or time consuming method, which has this end in view. There is, no doubt, a happy medium somewhere between the two extremes. I have at times found it distinctly advantageous to puncture intestines in facilitating their return to the cavity. My experience leads me to believe that surgeons have exaggerated the danger of dumping contents of obstructed coils into empty ones, lower down: this is borne out by the experimental work of Murphy and Brooks,[19] who found that absorption was hastened in proportion to intestinal damage.

The need of water in the treatment of a patient can not be emphasized too strongly. It must be liberally given in the rectum and under the skin, as outlined in connection with dynamic ileus.

Let us suppose the surgeon to have found a mechanical obstruction in a patient whose condition permits of radical surgery: what he does next must conform wholly to the special needs inherent to the kind of mechanical condition presented.

(a) Strangulation is, of course, to be relieved by cutting a band, dividing a ring, or in some other manner releasing the damaged coil and restoring it to its accustomed habitat. It is most difficult to state conditions under which resection is to be done for impending gangrene. My own observations incline me to think that we have erred in being too radical, rather than too conservative. Where there is the slightest doubt about its future, a damaged coil is by all means to be wrapped in rubber, and replaced for twenty-four hours, after which time, if nothing untoward happens, the abdominal wall can be completely sutured. There will, of course, be no question about the treatment of an already gangrenous segment.

(b) Obturation necessitates the removal of the bolus in question. I, personally, have removed an enormous stone from the jejunum, a fecal stone the size of a lemon, from the sigmoid, and an obstructing gauze pad from an unidentified coil.

(c) Volvulus is usually successfully treated by reposition and fixation, although, in one instance I cured a recurring affection of the ileocecal region by anastomosing the head of the cecum with the sigmoid.

(d) Meckel's diverticulum presents so great a variety of pathologic conditions that it can hardly be briefly treated here.

(e) Kinking may sometimes be easily relieved by dividing an adhesion or may at times demand a plastic operation, similar to the Finney, or others, which are well known in the pyloric region.

(f) Strictures, if benign, are also amenable to plastic operations, but if malignant, they demand resection.

The prognosis of mechanical intestinal obstruction is frequently a matter of the utmost uncertainty, since one never knows just when a lethal dose of toxin has been absorbed. I have seen patients gradually sink and die from patent failure of cerebro-vital centers, several days after an operation, which not only accomplished complete anatomic restoration, but was followed by the restoration of gastroenteric functions of every kind.

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CHAPTER XVII

FAT EMBOLISM

By O. F. McKittrick. St. Louis, Mo.

Fat embolism not infrequently follows operations, particularly orthopedic operations, and since the malady has attracted so little notice in the country until the last few years, it seems fitting that attention should again be called to this important subject.

The first contributions to fat embolism date back to the seventeenth century. Lower in 1669 injected 19 ounces of milk into the veins of a dog, the animal dying soon after in a spasm with all the signs of profound dyspnea. Later, similar injections[1] were undertaken for various purposes by Clark, Corton, King, Drelincourt, Gaspard and Beck. All these observers reported fatal respiratory disturbances but in none of the experiments were the lungs of the animals examined. Magendie[2] was the first to inject pure oil into the veins, and as a consequence of his experiments, was the first to prove that the lung capillaries can be plugged with fluid fat. Weber[3] and Schwick[4] in an effort to determine the effect of various emulsions on the circulation when injected intravenously, found that embolism did not follow such a procedure in their series of experiments. By injecting oil into the neck veins of a dog, Virchow[5] succeeded in finding, at the autopsy, many small fat emboli in the lungs and kidneys. H. Muller[6] was apparently the first to discover fat embolism in the human subject. In cases of chronic interstitial nephritis, he is accredited with having found fat droplets in the chorioid vessels. Zenker[7] and Wagner[8] were the first to observe fat emboli in the lung capillaries (Fig. 22), following the accidental fracture of several ribs and rupture of the liver in a man.

Considerable interest was now excited and many men investigated this subject, notable among whom were Hohlbeck[9] and von Bergmann.[10] At this time Busch[11] first definitely proved that the origin of the fat in these cases could be the bone marrow. Some time later Flournoy[12] proved Wagner's theory that fat embolism can occur after injury to the fat containing soft parts while Fritz made an independent demonstration of the same phenomenon. During the latter part of the nineteenth century Schriba[13] collected all the clinical and experimental data on this subject. His article, which appeared in 1879, is probably the most comprehensive work we have on the clinical manifestations of this malady.

The condition occurs most frequently following fractures and crushing injuries to the long bones, particularly those of the lower extremities. Operations on joints, surgical interference involving bone or even the forcible straightening of a contracted limb or of ankylosed joints, result not infrequently in fatal fat embolism. It is fair to assume, and the assumption is borne out by the literature, that this accident occurs only where fat is in close proximity to the lesion; force sufficient to propel the fat into an open blood vessel, being exerted. It therefore follows that contusions of the panniculus adiposus, hemorrhage into or rupture of the liver or osteo-myelitis predispose to this malady.

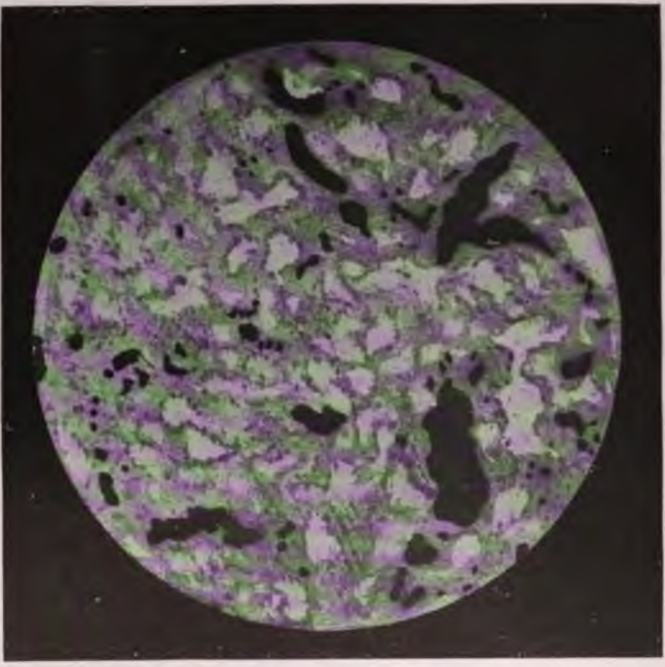

Fig. 22.—Fat embolism of lung following multiple fractures. (After Aschoff.)

Patients between thirty and forty years of age, form the bulk of those afflicted, while it is least common in children. This can be very properly ascribed to the fact that fractures occur more often during this period of life in the former, while the medulla of the bone in the latter contains but little fat. As to the frequency of fatal fat embolism, it should be stated that it occurs more often than was formerly supposed, though owing to the insufficiency of records it is hardly possible to estimate as yet the mortality rate.[14] Meet[15] collected 113 cases of fatal embolism but in only 11 of this number could he be certain that fat was the causative factor. To these are added two more cases which came under his own observation. Beitzke[16] reports a case of fatal fat embolism occurring within a few hours following a slight contusion to the leg stump, the operation having been performed a year before. Wahncan,[17] Colley[18] and Ahrens[19] each report a case in which fatal embolism occurred following brisement forcé which was being employed in an effort to straighten contracted limbs due to ankylosed joints. Schanz[20] records a case in which fat emboli produced death following an operation which involved osseous tissue. Ryerson reports four fatal cases due to this accident, two to three days following operation. In one case operation was performed in order to correct the deformity caused by a Pott's fracture one week old. Embolism followed after twenty-four hours and death within forty-eight hours. In another case following an Albee operation for severe paralytic scoliosis in a boy eight years old, fat embolism occurred in three hours followed by death after forty-eight hours. As a result of foot drop, due to poliomyelitis an operation was undertaken to correct the deformity in another case which developed fatal fat embolism twenty-four hours later.

The last case was a baby eight months old, operated for congenital club feet, the plantar fascia and Achilles tendon above being severed. The baby developed symptoms of fat embolism after twenty-four hours and died during the following day.

By far the greatest number of contributions to this subject are devoted to experimental studies and to the pathology,[21] all seeming to agree that the globules of fat after becoming established in the blood stream first lodge in the capillaries of the lungs. If the quantity of fat is of sufficient amount, severe symptoms will intervene, resulting very probably in death. If the patient survives the effects of the pulmonary complication and the heart's action is sustained, the fat globules will be forced from the lungs into the left heart and hence into the general circulation. From this they will be removed by the liver and kidneys, and unfortunately the brain and cord, and less frequently by the other various organs. Petechial hemorrhages may appear in the skin while at times ecchymosis may be seen on the mucous membranes and in the conjunctiva. In the experimental cases where fat embolism was produced, Schriba found the following lesions: "The liver was markedly congested with venous blood, fat cells being found throughout the parenchyma along the periphery of, and even within, the acini. The kidneys showed an abundance of fat, the glomeruli particularly were loaded with fat globules and many ecchymotic areas presented beneath the capsule. The brain and cord especially were the seat of most interesting findings. The coverings of these organs were congested with black venous blood, while the arteries here and there were free from this fluid. However, a cross section of the perivascular spaces showed them loaded with red blood corpuscles. In some of the cases the brains were only edematous but in a few the ventricles contained serosanguinous fluid, while in others there were found areas of softening. Such organs as the heart, stomach, intestines, bladder, muscles and even the skin were found to contain fat emboli in a number of other cases. The retina and especially the chorioid were often involved."

Hamig[22] reported five fatal cases of fat embolism of the brain. At autopsy many small ecchymotic areas were revealed in the gray and white matter, in the pons, medulla, and even the central ganglia; particularly in one case were the dura and pia congested and edematous.

The clinical picture in fat embolism is fairly well defined. The severity of the symptoms, however, depends upon the organ or number of organs involved. Payr[23] recognized two varieties, one the respiratory and the other, the cerebral. In a given case the most prominent symptom would determine to which variety it belonged. According to some observers there is usually an incubation period of from twenty-four to thirty-six hours following the operation or accident.[14] In very severe crushing injuries this period may be reduced to as low as three hours as in the case reported by Beitzke. Death itself has occurred within this time, though cases are reported in which it occurred as late as the eleventh day.[24]

The fat, as stated above, lodges in the lungs first. This is followed by difficult respiration, not a true dyspnea but rather an air hunger; there is pallor followed by cyanosis and failure of the circulation with physical signs of pulmonary edema, and the frequent expectoration of frothy, blood-stained mucus. The state of affairs continues to increase in severity as the lungs get more and more edematous and the heart weakens correspondingly. The milder cases will probably only show an air hunger recovering before further pulmonary symptoms develop. The temperature may go as high as 106° to 107°. Fat may appear in the sputum and in 80 per cent of the cases, in the urine, according to the authors who have reported the urinary findings.

As it would be naturally supposed the cerebral type is of less frequent occurrence. The entrance of the fat into the cerebral circulation is marked by nausea and vomiting, followed by delirium, somnolence and finally coma, hemorrhage, and thrombosis. Localized paralysis, trismus, and convulsions were noted in some of Hamig's cases, and Schanz reports one instance of hemiplegia. The respirations are usually stertorous. The temperature uncomplicated by other conditions is normal or subnormal, and is associated with a rapid weak pulse.

Unfortunately there is no *specific* remedy for this condition. According to many observers a considerable decrease in the number of instances can be obtained by bearing in mind the likelihood of this accident and giving careful attention to the prevention. Burger[25] who has studied this phase of the disease on the battle fields of Europe, during the last war, states that the tourniquet is probably the best means we have of warding off fat embolism. He advises its application in all cases of fracture, severe crushing injuries of the limbs, or general contusions to the bones in those weakened from disease or in the aged. In very severe cases especially with crushing injuries of the pelvis, he uses Monberg's constriction at the waist line for at least half an hour; at the end of which time it is gradually loosened. Another precaution is to avoid the moving of such patients to very great distances, as this particularly predisposes to the malady. Premature massage or even the handling of the patient or unnecessary disturbance of any kind may end in dire results.

Extensive laboratory experimentation on dogs and rabbits by Ryerson has shown that fractures and contusions of the bones cause much more embolism than does the performance of a typical Albee bone transplant to the spine, for instance. However, the use of the chisel and mallet in the performance of this operation is far more dangerous than the motor saw. The experiments also showed fatty embolism is markedly decreased by the use of the tourniquet following all kinds of traumatism. Apparently all authorities are in accord with this view, but up to the present time it has not been used as a routine measure by any one man.

If the accident occurs regardless of the above efforts, emergency medical measures as recorded for pulmonary embolism should be applied here. Protracted absolute rest of the affected part must be particularly insisted upon, inasmuch as additional quantities of fat may continue to enter the circulation. The heart's action should be sustained with strophanthus or digitalis during its attempt to force the fat globules through the pulmonary capillaries in an effort to relieve the embarrassed respiration. It is a question whether the class of remedies exemplified by amyl nitrite should be used to force a dilatation of the peripheral and pulmonary vessels since this additional strain may be too great for the already overloaded heart.

Later, while the oil is being disposed of by the liver and kidneys, assisted by the process of oxidation and of saponification effected by a ferment in the blood plasma and by the metabolic and phagocytic activities of the leucocytes, the medical treatment can be symptomatic only. Further treatment as proposed in the recent literature is apparently not on a well-defined basis. Czerny[26] in an attempt to assist the blood in forming a soluble soap injected 2 per cent sodium carbonate, but the method received little support. Schanz injects subcutaneously a liter of normal salt solution at the first sign of trouble; various parts of the body being utilized for this purpose in order, he thinks, to more promptly and effectually accomplish the desired dilatation and flushing out of the capillaries involved. He reports ten cases of fat embolism occurring after operation on the bones with the loss of only one patient after employing this method. While others, notably Beitzke, do not sanction this treatment, I feel that it should be given a trial so long at least as the solution is not given intravenously. It is also advocated by Gangele.

Wilms[27] drained the thoracic duct for four days with recovery of the patient. Tanton[28] recommends this procedure also. They base this action on the theory that the fat is carried principally by the lymphatic system rather than by the venous. Though the fat contained in the thoracic duct may be the metaphorical last straw, Wilms' method receives but little support.

Riener[29] advises draining off the venous blood with its admixture of fat by means of a cannula inserted into the saphenous vein and hence into the femoral vein. He says that the amount of fat necessary to cause the initial symptoms sufficient for diagnosis, does not always produce death, the fatal dose having not as yet passed the Poupart's ligament. This method is approved by other observers. Tanton would open up the area of injury and remove the accumulated blood and fat, using drainage or tamponade, a procedure having many advocates.

Venesection relieves the heart which is beating against the fat emboli in the greater circulation and should be employed in suitable cases. If brain pressure symptoms develop from the venous stasis or hydrocephalus, leeches to the mastoid may be of aid in diverting the fluid. Lumbar puncture may be applied with caution.

After the recovery from the immediate effects of the accident, I would naturally expect a longer convalescence of the patient than without this complication. Dizziness, fatigue, dyspnea, heart disturbances or even mental depression may be present for an indefinite time. If such are prominent, however, lumbar puncture supplemented by hot foot baths, air and sun baths, and revulsive measures should be carried out. The patient must be warned against over-exertions either mental or physical. If possible, give him light work and let his ordinary occupation be gradually resumed.

Bissell[30] writes: "It would seem reasonable to conclude that in persons with broken bones there is frequently a remarkable amount of fat in the blood stream, and almost incredible amounts of fat may be in the blood and yet not kill. Further, it might be assumed that the amounts of fat free in the blood stream of persons with broken bones vary from time to time, and it is very essential for any interpretation of these results to remember that in no instance was the whole blood examined; that other similar amounts from the same patients (or dead bodies) might have shown a fat content either greater or less, since the fat is not emulsified but is in motion as free fat droplets, and no doubt these vary from time to time in their number and size as well as in their distribution, the blood in some places perhaps being rich in fat and in others poor or with no fat as emboli."

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CHAPTER XVIII

HEAT STROKE

By O. F. McKittrick, St. Louis, Mo.

In addition to the ordinary dangers attendant upon an operation, there is another which occurs in summer during or immediately following a heat wave. This condition has been considered "heat stroke" by Gibson who apparently was the first to recognize the malady as an important postoperative complication. This author reported two cases in 1900. Shortly thereafter Johnson and Becker reported three and one cases, respectively. Since this time less than half a dozen more cases had been brought to the attention of the medical profession when Moschcowitz[1] in 1916 added five more to the list.

This complication according to Moschcowitz is apt to follow a long-continued term of fairly high temperature with a high percentage of humidity and no breeze, rather than an exceedingly high temperature with a good breeze. He has noticed that the longer the former atmospheric state exists the greater will be the number of cases recorded.

The condition is considered one of heat stroke since the patients present symptoms, more or less like those of sun stroke; though of the cases recorded only one was in any way directly exposed to the rays of the sun. In every instance except this one, all the patients had been sick either at home or in the hospital prior to the operation.

As to when the onset of symptoms occurred, nothing as yet can be said definitely, since all the patients were operated on under general anesthesia. In some of the cases symptoms of this malady had begun to assert themselves before the patient was entirely awake from the anesthetic while in others more than twenty-four hours had elapsed.

One of the patients, a boy, as reported by Moschcowitz was operated for appendicitis. Some pus was found and the abdomen was drained. Following partial recovery from the anesthetic the child was restless and noisy. The temperature started to rise and five and one-half hours after operation it had reached 105.6°. The exposed parts of the body where then sponged with ice water and ice was put on the head. In spite of this the temperature continued to go higher and thirteen and one-half hours after operation it had reached 109°. Four hours later the patient had a convulsion which lasted twenty minutes. One hour later another convulsion occurred followed by death twenty and one-half hours after operation. The temperature never fell below 105°, and no reason, outside that given, could be assigned as the cause of death.

In another case reported by Gibson[2] the patient was doing nicely following an operation for acute appendicitis, until the afternoon of the following day. At this time the temperature had gone to 104°, the pulse to 148, and was very poor. The face became ashen gray, the nose pinched, and the skin hot and dry; there was restlessness and delirium. As soon as the condition was diagnosed, alcohol sponge baths reduced the temperature in a short time and the patient went to sleep. The patient soon after recovered without any apparent ill effects.

The condition is a serious one and no doubt has resulted in many deaths attributed to other causes. In many hospitals the patient is completely wrapped in blankets during the operation or the transportation to and from the operating room and finally so enveloped in bed as to prevent chilling and ultimately pneumonia. This habit during hot weather is no doubt very likely to lead to overheating with the appearance of this dangerous complication.

The treatment concerns itself with the prevention of any undue heating of the patient. Even in the operating room whenever indicated an ice cap should be placed on the head of the patient as has been already suggested by others.[3] The clothing should be very light and the covering cool and airy. Cool drinks should be given before operation also ice by mouth as soon as the patient awakes from the anesthetic. Electric or manual fanning could be kept up if the patient is in need of such treatment.

If, in spite of such preventive treatment, the patient develops a high temperature with the attendant symptoms of heat stroke, frequent alcohol or cold sponging of the whole body must be instituted and cold water proctoclysis be started. If this is not borne by the patient colonic flushings with ice water should be carried out.

If the hyperpyrexia still continues regardless of these measures, the patient is covered with a cold wet sheet upon which is laid many small pieces of ice. Ice water now is allowed to drip for twenty to thirty minutes on him from drippers held 8 to 10 feet above the bed. A fine stream of ice water as suggested by Chandler[4] is poured on the head for one or two minutes at a time. When the temperature has dropped to 104° as evidenced by a thermometer which has been kept in the rectum throughout the whole procedure, these heroic measures are at once discontinued. The patient is now wrapped in a blanket and hot-water bottles applied to the limbs and trunk. Under no circumstances give an antipyretic but stimulate the heart. The drugs which are best for this purpose can be selected as the occasion arises. If breathing stops, artificial respiration must be carried out for at least one hour before the patient is given up. Alcohol is especially indicated where there has been excessive indulgence during health.

Heat Prostration.—Instead of the high temperature, the hot skin and general symptoms of heat stroke, the patient may present the picture of syncope, with shallow labored respirations, dilated pupils, cold, clammy skin, a subnormal temperature and a small, soft pulse. This condition is brought on by exactly the same factors which cause heat stroke. It is called, however, "heat prostration." The treatment is directly opposite that described for the complication above.

The foot of the bed should be elevated at once, the patient covered with blankets and surrounded with hot-water bottles. Subcutaneous salt solution is to be continuously kept up until the patient revives; in addition proctoclysis warm plain tap water is in order. If the blood lakes as some observers have noted, venesection should be done and blood transfusion carried out if a suitable donor can be had on short notice. Here, as in the condition above mentioned, careful attention must be given the heart.

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CHAPTER XIX

POSTOPERATIVE BURNS

By Willard Bartlett, St. Louis, Mo.

The consideration of postoperative burns would furnish an unnecessary and even obsolete chapter in the annals of after-treatment if human ingenuity could reach that degree of perfection in which no mistakes are made and all little preventive acts are remembered; since this complication arises only when some one connected with the operation or postoperative care, has blundered. The occurrence, therefore, of this accident is always a matter of most serious regret, one always causing marked annoyance to the patient and in many instances chagrin or even medico-legal worries for the physician.

The general subject of burns can not be treated in a work of this kind, hence only those occurring as a postoperative complication can be discussed. Here follows a list of the varieties with which we have been confronted, by no means all of them caused by heat alone.

Depilatory Burns.—One of the unlooked for accidents associated with an operative procedure at times occurs after the use of depilatory chemicals in hastily preparing a hairy field for operation. Fortunately such agents are not in very common use at the present time, else such lesions would no doubt be more commonly seen.

Depilatory burns may be serious if the chemical be confined on the skin for any length of time. I once had to prepare a patient hurriedly upon the table, for a lengthy abdominal operation, with the result that a small amount of the calcium sulphide, which we were using ran over the patient's side and was confined between her back and the sheet upon which she lay. An extensive and serious burn resulted which had not healed when she left the hospital, twelve days later, and of which she complained more than she did of the effects of the operation which had been performed. It is questionable whether depilatory agents should ever be used, since their action is at best uncertain, and unless accurately timed, will destroy the epidermis along with the hair which alone it is intended to remove.

Iodine Burns.—Another cause for this complication is the use of that efficacious, yet dangerous chemical, iodine, which is now so commonly employed for skin disinfection. This agent acts differently on the skin of different patients; some seem to bear it with impunity, while others acquire burns wherever it is applied and many of them require from one to two weeks careful treatment before the skin is normal again. If one hopes to use iodine successfully he must avoid applying it to skin which has been recently moistened. If the skin must be shaved immediately before its application, it is imperative that this be a dry shave with benzine or some other nonaqueous fluid. If this is impossible, alcohol and ether may be employed to sufficiently dry the skin surface or else one must wait until it becomes dry of its own accord. I am confident that many iodine burns could have been avoided by the careful observance of this well-known fact which was embodied in the earliest writings on this subject. The excess of iodine which remains around the edge of an area prepared for operation, or that remaining after the operation is completed, should be carefully removed with alcohol. Some hospitals employ sponges saturated with starch water for this purpose, a practice which can not be too highly recommended. The starch, as is perfectly well known, completely alters the chemical composition of the drug; this aids materially in preventing the unpleasant after effects of an excess of this irritating substance on the skin.

Ether Burns.—During the operative procedure burns may also occur from ether which has been spilled. In fact, burns about the face and neck are very common in the hands of anesthetists who persist in using an impervious cover of rubber, gutta percha, etc., for the eyes and adjacent exposed skin. As mentioned in the discussion on ether conjunctivitis, this fluid or even its vapor when confined under impervious material creates a burn which is exactly limited to the extent of the skin covering employed.

Hot-water Bottles.—Perhaps the most common of all postoperative burns result from the contact with *hot-water bottles.* These should, of course, always be tested by a thermometer, but are probably very rarely so tested. In consequence the nurse's hand, being accustomed to a degree of heat that will astonish any man, establishes a standard for her patient by guesswork and then she applies to a surface which is much more sensitive than the hand, a degree of heat which it can not at all tolerate and later is at a total loss to account for the burns which constitute one of our most prolific sources of medico-legal complications.

Glass bottles should never be the medium of applying heat to a patient, since their very nature makes equal pressure everywhere upon the skin an absolute impossibility, and heat applied with considerable pressure upon one point is more certain to damage the tissues than if the same degree be applied in the form of a yielding rubber container which molds itself readily to the outline of the part with more or less equal pressure everywhere. It is doubtful whether heat should be applied at all, where it can be avoided, to a patient who is still unconscious from the anesthetic and thus unable to convey to his attendant any impression of the sensations produced. The application of heat through the medium of hot water has one disagreeable feature no matter what form of container is used; namely, a leak is very likely with the consequence that the patient lies in a puddle until the accident is discovered and in some instances thereafter for an indefinite time. The electric foot warmer now so commonly used can be adjusted to suit the requirements of the case, and since it works at different temperatures easily predetermined it is by all means to be recommended.

Enemas.—Burns from enemas are no doubt very rare. I happen to know of one instance, however, in which a hospital was sued for malpractice by a patient who claimed to have suffered from an accident of this nature. While she was unconscious after the anesthesia a douche point had been inserted in the rectum and connected through a partially opened stopcock with a can containing water hot enough to reach the rectum drop by drop and still be quite warm. The nurse left the room and the patient moved in such a way as to open the stopcock, with the result that there was a free flow of water so hot that the mucous membrane and skin of the anal region were destroyed this being followed by extensive scar formation.

Burns of the mucous membranes of the mouth occur from *ingestion* of too hot liquids, but are of such a trifling character as to be practically negligible.

The electric light treatment for open wounds which has come so strongly into vogue in the recent past has contributed the most modern chapter to this subject. To be thoroughly efficacious the light bulb must come within a few inches of the region to be treated, hence it is readily understandable that the sudden movement of a sleeping patient or indeed, of one awake for that matter, may bring the glass bulb into immediate contact with the body with the most disastrous consequences. In one instance where the bulb was suspended in my practice immediately over a large suppurating appendix wound, a faulty connection gave way, the incandescent bulb fell onto the patient who happened to be asleep, and before it was removed, a second degree burn of considerable extent ensued with the result that wound healing was distinctly complicated and lengthened thereby.

In other instances where heat is maintained by a number of electric bulbs arranged as in the Gellhorn apparatus, or hanging suspended far above the patient and inclosed with him in a specially arranged "burn bed" these may cause superficial burns of the parts of the body exposed. In such beds the temperature is maintained by covering the frame which supports the lights with blankets, oil cloth, or other materials. The degree of heat desired is about 85° C. but occasionally it becomes excessive, and although the patient is very uncomfortable, complaint and examination are often not made until damage has been done. I have seen two instances in which superficial first degree burns occurred under such circumstances. In one, a burn of the skin over the abdomen appeared in a woman patient who fell asleep and the nurse, not acquainted with the efficient apparatus for developing heat, allowed the part exposed to become so injured that it was several days before the skin assumed its normal appearance.

In the other instance a leg having been amputated for indolent ulcer and the tissues being very slow to heal due to arteriosclerosis, the patient was kept in bed with the stump and lower part of his body kept covered by a frame from which several electric light bulbs were swung at least 16 inches high. The frame was in turn covered by two blankets, the upper portion of the body being outside of the enclosed portion of the bed. Within one-half day the hyperemia became so extensive and the pain so severe that it was deemed advisable to discontinue the treatment. The skin over the exposed regions gave all the signs of a superficial burn, and was four days in recovering from the effects of this treatment.

X-ray.—The x-ray is another factor to be considered in the etiology of postoperative burns. So often is this method of treatment instituted, particularly after operations for malignancy, that it is no more than natural to occasionally expect a complication of this sort. I have seen one or two such instances, though the condition is not so common as one would expect when the number of cases so treated are considered. Probably this is due to the fact that the nature of the treatment itself requires more expert application than does the usual routine after-care and is therefore handled by a special class of men skilled in their individual work. Sajous[1] in discussing the subject says: "Close proximity to the ray by either covered or uncovered parts results either in superficial or deep inflammation of the skin. It may be observed a few hours after exposure to the rays or may be delayed for several weeks. This form of burning attacks the skin alone in some instances, while in others the deeper structures, as the muscles, tendons, nerves, and bones (periostitis and ostitis resulting) are involved. The effects may remain for days, weeks, or even months after the application. The x-ray burns are supposed by some to be produced by the action of the ray or by particles of aluminum or platinum reaching and being deposited in the tissues by others, and by yet others to be the result of an interference with the nutrition of the part by the induced static charges."

The effects of these static charges can be absolutely eliminated according to Sajous[1] by interposing some conducting material, one readily penetrated by the rays, such as a sheet of aluminum or gold leaf. "As an added precaution we have found it extremely valuable to have treatment administered by an experienced roentgenologist, one thoroughly familiar with the work in hand. Such men inform us that it is not so much in protecting the parts to be x-rayed with aluminum as the giving of too frequent small doses or a too long exposure at one time."

Ice.—The application of *ice* continuously for several hours may result in the complete destruction of skin with a resulting lesion so similar to a burn that for all practical purposes it is well classed under this common heading. I was recently shown a most extensive burn of this sort by a colleague at the Jewish Hospital of this city. During the course of a pelvic inflammatory disease an ice bag had been continuously applied for many hours directly upon the skin of the lower abdomen until at the expiration of this time nutritional changes had commenced which finally resulted in a slough equal in size to the bag itself. The effect of ice upon the tissues is very rarely as extensive as that here mentioned, still all of us have seen a red, tender edematous area persist for many hours after a too long continued application of this sort. Treatment in this instance should be preventive in nature, the rules underlying it being of such an exceedingly simple nature that their nonobservance is almost inexcusable. An ice bag should under no circumstances be applied directly upon the skin, but should have one or two layers of flannel cloth beneath it; even then no ice bag should remain *in situ* for more than two out of three hours at a time.

Pathology and Morbid Anatomy.—From the pathologic standpoint, the effect on bodily tissues of various caloric agents is essentially the same. The amount and severity of the change depends on the intensity and duration of the agent, the extent and location of the involved area, and whether the normal equilibrium of the skin is disturbed by local infection or lowered constitutional resistance.

It is customary to classify burns in three degrees. *First.*—Characterized by simple erythema and destruction of only the superficial layers of the epithelium, with occasionally some slight swelling of the part. *Second.*—In this class, in addition to the above there is formation of bullæ or blebs filled with clear serum; and considerable swelling. In neither of these classes are the deeper crypts of epithelium destroyed, and regeneration takes place with little or no scar formation.

Third.—Typical of this degree is the carbonization of the dermis and deeper structures with eschar formation. In this type the necrotic tissues slough off, leaving an ulcerating surface which slowly heals by granulation, scar formation, and cicatrization.

Accompanying the above changes are the usual manifestations of inflammation with suppuration. Suppuration is furthered by the formation of scabs.

Because of the excellent culture medium afforded by the abundant serous exudate and autolyzed necrotic tissue, infection is especially prone to occur, which not only retards healing but seems to favor more extensive cicatrization and contractures.

In addition to these local changes, certain alterations in the viscera and serous membranes are observed in patients dead of extensive burns. Bardeen[2] reviewed the literature on this subject and in addition laid especial emphasis on edema and focal necrosis of lymphoid tissue with increased cell proliferation. Cloudy swelling and parenchymatous degeneration of the liver and kidney, enlargement of the spleen, edema of the lungs, meningeal and general visceral congestion are quite constantly found. Recently Weiskotten[3] has called attention to a condition of edema and necrosis of adrenal tissue which he believes is characteristic of burns.

A number of theories have been advanced in explanation of these changes which are discussed in full by Vogt.[4] It is probable that hemolytic, cytotoxic and neurotoxic substances are formed in the burned area which bring about the visceral and blood changes as well as the condition of shock so often seen following even comparatively slight burns. There is considerable disagreement among investigators as to the nature and action of these substances. (For fuller discussion see Wells, Chemical Pathology.)

Blood changes are manifested in sluggish circulation and assumption of a darker purplish color. The erythrocytes are increased two to four million in fatal and one to two million in nonfatal cases. Fragmentation, clumping, and distortion of the red cells with tendency to thrombus formation occurs. There is loss of water, hemoglobinuria and hematuria. The platelets are notably increased with marked tendency to clot on part of the blood. In fatal cases a rapid leucocytosis of 50,000 or more, and in the nonfatal of 30,000 to

40,000, is found.[5] Coincident with this leucocytosis there is considerable destruction of leucocytes.

Burns following exposure to x-rays differ somewhat in their pathology from burns resulting from direct contact with a caloric agent. Here again three general classes may be distinguished: *First.*—In which there is simple erythema. *Second.*—In which there is inflammation with loss of epithelium. *Third.*—In which there is deep ulceration. In addition to these more or less external manifestations, certain changes occur in internal organs directly subjected to the rays, characterized by destruction of the parenchyma with increased connective tissue formation. Such changes are most evident a week or ten days following exposure. There is intracellular edema, and pyknosis of the cells. Cells of the embryonal type are most easily affected.

The changes in the skin and immediately underlying structures are:[6] rarefaction of the superficial layers of the corium with increased density in the deeper layers; hyaline degeneration throughout the corium; increase in elastic tissue; vacuolation and hyalinization of smooth muscle fibers; obliteration of lymphatic spaces; dilatation of superficial capillaries with obliteration of large vessels and deeper anastomosing capillaries, due to proliferation of endothelium and thickening of the media with subsequent thrombosis; destruction of the hair follicles and sebaceous glands following long or repeated exposure; appearance of abnormal cells. It is easy to see that such vascular and lymphatic changes would cause serious nutritional disturbances and as a result there is hypertrophy of the epidermis with keratosis in places, and in other areas atrophy and necrosis which give rise to dry, superficial and deep, indolent ulcers usually having tough adherent membranes and which heal imperfectly, leaving hard, poorly vascular scars which tend to break down readily. In some cases repair is never complete. With such areas of necrosis alternating with areas of active epithelial proliferation it is not unusual to find strands of epithelial cells invading the deeper structures and thrombosed capillaries, with formation of actual skin cancer. Destruction of lymphocytes due to action of the rays of blood-forming organs, particularly of the lymphogenous type, is commonly seen.

Similar conditions, though not so severe, are seen following excessive exposure to radium.

Symptoms.—The systemic symptoms which accompany this lesion of first degree are comparatively slight, except in nervous individuals who are markedly influenced by pain.

It is commonly believed that a temperature of 150° F., or higher, will produce a burn of the second degree, this being especially true if prolonged contact with the destructive agent be maintained for a long time. The appearance of such a burn does not differ very markedly, except in extent, from that of the first degree. The systemic symptoms are decidedly more pronounced than in burns of the first degree, this being especially true if an infection, which at times is avoided with difficulty, takes place. While the suffering may at first not be more pronounced than in burns of the first degree, it has a tendency on the other hand, to be of much greater duration. In fact, with nervous individuals it may last almost indefinitely.

In a burn of the third degree the systemic symptoms are in proportion to the amount of tissue destruction, although pain is not so frequently complained of as in the first two types described, for the simple reason that nerve filaments and trunks have gone the same way of other exposed tissues in the general destructive process. In a few days the slough begins to separate, and if all goes well, granulation tissue makes its appearance in the walls of the defect. If a serious infection has been prevented, the granulation tissue normally is converted into a scar, which contains no hair follicles, sebaceous glands, or chorionic villi, but is merely covered by a flat stretch of surface epithelium, the results of ingrowths from the borders of the defect, or else the product of skin grafting. Such scars have two most undesirable tendencies. In the first place, keloids may result from them, or their tendency to contract may produce most hideous and crippling deformities.

If the burned area is extensive, the accompanying shock may be very marked. It is quite commonly thought that destruction of one-half the body surface is sure to result in death, although, of course, this depends very largely on individual resistance. One can quite easily imagine an individual in whom a very much less extensive burn than that just mentioned, might result fatally.

Of course, we do not often see extensive burns during postoperative treatment. However, the amount of shock following such an accident, occurring in the course of a tedious convalescence, might be expected to be disproportionately greater.

It may be stated in general, that the extremes of life do not bear the effects of burns very well. This holds good for the postoperative, as well as for the ordinary variety.

If the burned surface has been extensive, we note that the urine is highly acid, small in amount, contains albumin, and frequently casts. Blackfan and Higgins[7] of the Johns Hopkins Hospital have found that there is frequently an acidosis in children suffering from superficial burns. The acidosis may develop within a few hours after the injury, or it may be present as a terminal manifestation. The earliest clinical sign of acidosis is hyperpnea. The laboratory evidence of the acidosis was established by diminished alveolar carbon dioxide tension and a diminution of the alkali reserve of the blood. The cause of the acidosis has not been determined definitely. It is not due to the acetone bodies, it may prove to be due to retention of acid phosphates, dependent upon kidney deficiencies. If so, then it is analogous to that occurring in nephritis as has been demonstrated by Howland and Marriott. The acidosis in burns is only one symptom and is probably not the cause of death, but its presence indicates vigorous therapeutic measures. They suggest as the result of their observations that alkalies be given prophylactically after severe burns, and when an acidosis, as determined clinically by the hyperpnea, or by one of the laboratory tests, develops, energetic treatment with alkalies be instituted. It has also been noted by some authors that a transitory glycosuria results in a few cases and it apparently is not necessary that the burn be severe to bring about this complication.

Frostbite

For want of a better term in describing the action of cold, as we occasionally see it in postoperative treatment, we have adopted the caption "frostbite." Ormsby[8] in discussing this subject states that "in the first degree injury which usually follows short exposure to extreme cold, there occurs erythema and then swelling after the parts are warmed. During the freezing process there occurs slight pain followed by loss of sensation, and the area presents a pale appearance from contraction of the blood vessels. As the circulation is restored, hyperemia and edema follow. Occasionally a more or less permanent redness supervenes.

"In the second degree the edema and erythema are increased with the production of vesicles and bullæ. These undergo involution without the formation of scars.

"In the third grade gangrene may occur with and without the formation of bullæ. The frozen part may become insensitive, white, and cold, without the circulation in it of blood and lymph currents. From this condition reaction occurs, with the formation of an eschar, differing according to the severity of exposure to cold. If, however, besides the interference with the circulation, the tissue itself has been destroyed, when reaction occurs the parts fall at once into gangrene;

or there form bullæ, larger than those described above, filled with sanguinolent serum; or the skin is smooth, marbled with bluish lines, whitish, cold, and insensitive. Gangrene ensues, followed by the well-known phenomena of the 'line of demarcation,' and separation of the dead part, granulation, repair, and cicatrization."

Prognosis.—The prognosis of burns or frostbite in the after-treatment can hardly be put upon the serious plane which often characterizes these lesions at other times, since fortunately, such accidents in the hospital do not result in the extensive tissue destruction often seen in burns of the customary variety. It is well to add in this connection, that it is the extent rather than the depth of a burn which is especially serious, as far as the life of the individual is concerned.

The most serious complication likely to ensue after a postoperative burn is an infection. Fortunately, however, for the individual so unfortunate as to be injured within the hospital walls, we are usually in a position to prevent or combat this secondary complication. Tudor[9] reminds us of one matter important in this connection, that the anaphylactic reaction which follows the absorption of toxins from burned tissues is not to be overlooked as an important factor in these cases.

About the worst prognostic features in postoperative burns are deformities, scars, prolonged stay in the hospital, the patient's damaged morale and the heightened tendency to malpractice suits.

Treatment.—So many remedies have been proposed in the *treatment* of burns that one can be reasonably sure that not many of them are highly satisfactory. I no longer employ any of the oils, picric acid, or one of the other thousand and one agents which discolor the individual's skin or render his habiliments greasy and unfit for further use. We have not found a chemical substance which is productive of immediate relief from pain when used as a local application. To accomplish this highly desired result, we rely upon morphine alone, and know of no other drug which in any measure will take its place. We think of nothing more cruel at this time than the application of a gauze or cotton dressing, which must be changed at intervals and thus subject the damaged and oversensitive tissues to repeated traumata. So far as I can judge at the present time, there seem to be just two reasonable courses open to us in treating a burn, no matter what the degree.

Presupposing in both cases that the part has first been put at rest and kept so, we may cover the burned area with paraffin and completely exclude the air, and in this way may obtain the maximum of relief, and at the same time do a great deal toward preventing accidental infection. While this suggestion is by no means a new one, still, I think we may safely claim for it that one of the many contributions, which the genius of the French has made to clinical surgery during the great war, is the treatment of burns with a coating of paraffin. Howarth,[10] after much experimenting is convinced that patients are made much more comfortable and that healing is hastened by daily applications of paraffin, either in the form of a liquid spray or if put on with a brush, or even if applied as a plaster on cotton.

The material must be made flexible by a slight modification, the following prescription being suggested.

Paraffin, 70 gm.
Liquid petrolatum, 3 c.c.
White beeswax, 10 gm.

This is to be melted in a double boiler, and applied after the surface has been dried by the electric fan, else this layer will not adhere.

The second choice, to which I have referred, in the treatment of burns, concerns itself with the immediate exposure of the affected area to the air, the body heat being kept up by means of a number of electric light bulbs swung from the cradle which holds the bed covers off the exposed part, or else the patient is placed in a burn bed. The crusts may be softened by applying every few hours 4 per cent boric acid ointment, which after being retained on the lesion for one hour is again gently scraped off, the patient all the while being kept under the direct rays of the electric light. The object of the light is to act as a drying agent, at the same time maintaining body heat so that a patient, though partly or even completely undressed and exposed, may lie in comfort. In order to gain sufficient heat it is sometimes necessary to replace the tungsten electric light bulb by the old-fashioned carbon filament bulbs, which emit less light but give considerably more heat. Light and heat are further regulated by decreasing or increasing the number of bulbs or more lightly covering the cradle, depending on the amount of either desired. Ravogli[11] instead of continuing the open air treatment, even while the boric ointment has been applied, covers the part with "English Lint." I do not consider this absolutely necessary, at least in many cases, and it may dislodge the various small islands of epidermis which have in the meantime sprung up here and there over the granulations.

Let us suppose that in the course of time, all the sloughs have come away or have been removed, and the wound has become clothed with healthy, velvet-like granulation tissue. As the epithelium from

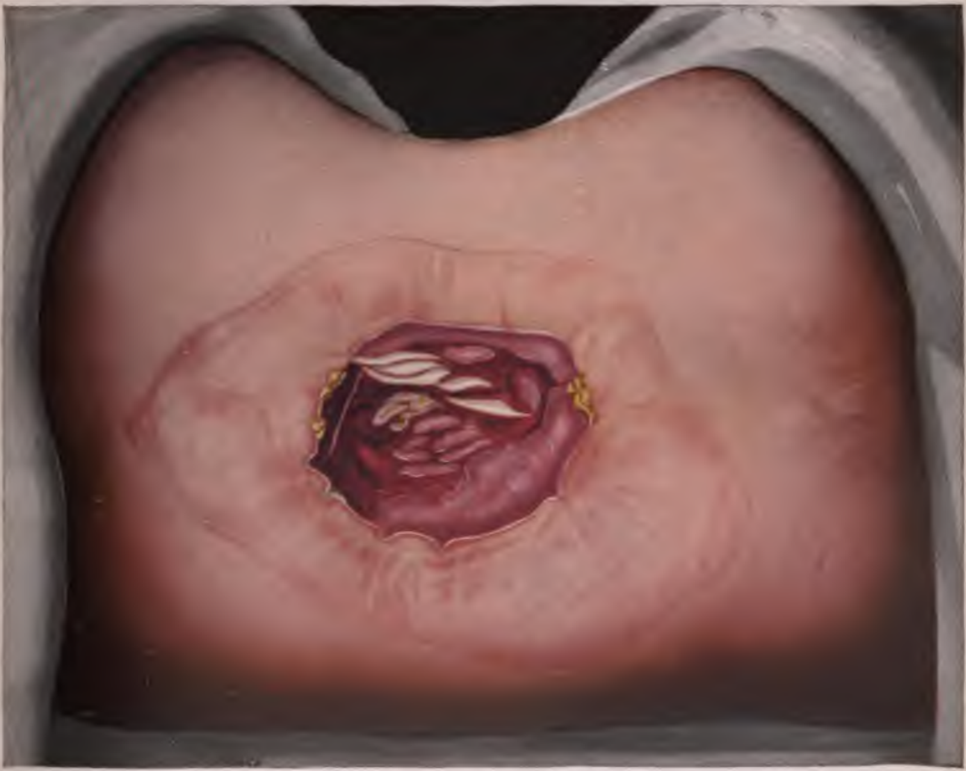

Fig. 23.—Skin grafts on an extensive burn surface.

the skin edges creeps over the granulating wound, its progress is hastened by placing each day new areas of Reverdin skin grafts (Fig. 23), which will readily take over the areas of healthy granulation tissue. If for any reason the granulations are pale and whitish, as is seen often after x-ray burns, balsam of Peru may be applied along with the treatment discussed above, and here small grafts of the whole thickness of the skin, after the Wolfe-Krause method, may be applied without awaiting for areas of healthy tissue to appear. It will be found that some will take and from around them the granulation will become normal in appearance. In carrying out the skin grafting, the skin should be taken from the patient himself. A solution of ½ per cent novocaine with 1:1000 c.c. adrenalin in salt solution being used to anesthetize the skin area. A sharp pair of scissors and a pair of small mouse tooth forceps are all one needs in securing the grafts.

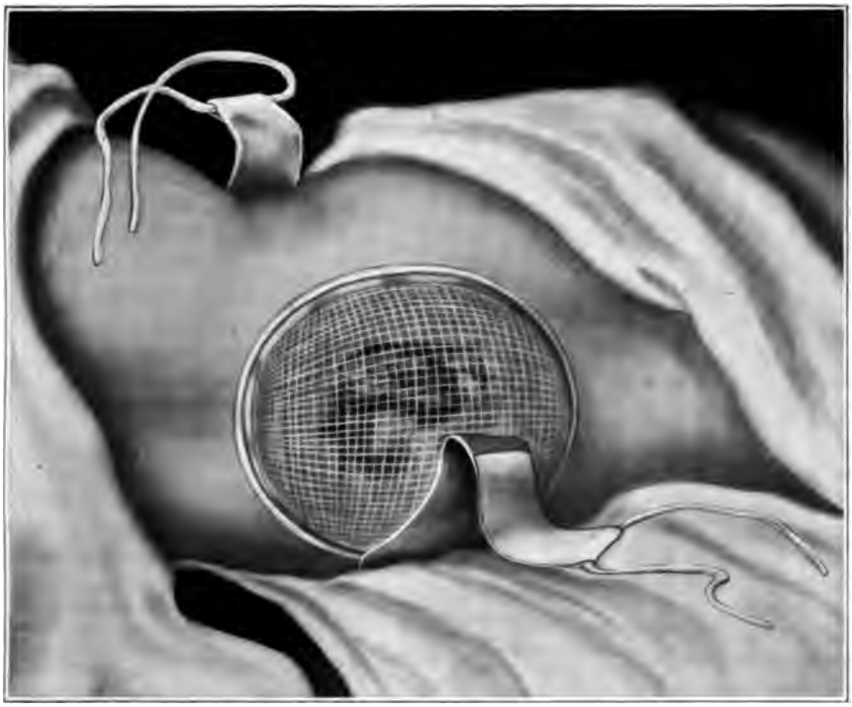

Fig. 24.—Wire cage to protect skin grafts on burn surface.

I recall a patient who was severely burned while the results of a bismuth meal were being observed. The lesion, a third degree burn, extended over a considerable region of the back. After months of treatment with all the methods advised in the foregoing paragraphs, most of the defect was healed. The epidermis regenerated, and finally nicely covered the whole region except for a bat-shaped area four inches long and three inches wide in the center of the small of the back. This was filled in with pale granulation tissue and was extremely painful. This area was excised in its entirety and allowed to fill in with new granulation tissue which was indeed slow to develop. The part was covered with an ordinary wire sieve (Fig. 24) and the patient allowed up and around out of doors. The new granulations were whitish and certainly not healthy in appearance, but the operative procedure had stopped the pain which, of course, is the first factor to consider in these cases. As quickly as the defect filled with the new tissue, Wolfe-Krause grafts were used, with the result that after one or two trials, a "graft took." Around this nucleus the granulations became red and healthy. This permitted more successful skin grafting and quick covering of the denuded area with normal skin.

The *systemic* treatment is considered very important in burns of any degree. In those of second or third degree, it is imperative that this part of the individual case be not overlooked, while the local management is being carried out. In those cases requiring the open air treatment from the very first, I do not hesitate to give morphine, as it is needed for the first few days; it apparently aids materially in combating the shock.

We are not often confronted by a serious acidosis or other form of autointoxication in the relatively restricted burns which occur during surgical after-treatment; still, it may not be amiss to mention in this connection the fact that the use of sodium solution, morphine, carbohydrate feeding and plenty of water are of use in this connection.

In the treatment of injuries due to cold, the same local and general measures may be employed as discussed for like injuries due to heat. At first, cold applications may be applied to the injured surface, as the pain in most cases will be too severe to suddenly cause marked reaction by the application of heat.

Full credit is due O. F. McKittrick for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER XX

BEDSORES

By O. F. McKittrick, St. Louis, Mo.

Bedsores have been the subject of considerable discussion and writing throughout the years of medical and surgical advance. It is one ever requiring the most minute attention of those in charge of the unhappy victim and even then, the ultimate outcome may be such as to seriously impede the recovery of infirm patients, particularly after a major operation.

The lesion is a local anemia which finally results in moist gangrene due to continued pressure on some particular area. Zipperling,[1] who has recently considered this complication, states that Samuel,[2] in his study of the effects upon the skin and underlying tissues, was the first to give the name "decubitus" to these lesions.

Zipperling in discussing lesions of the spinal cord and brain has observed decubitus develop apparently from this source alone and refers to Leyden, who, he says, first made a short mention of "Acute Decubitus" in his text book. Later on Erb[3] fully described the malady. His writings were soon followed by those of Eulenburg.[4] That injuries and lesions of the cord or brain may cause decubitus has been held true by others although the general opinion that lesions here are more commonly predisposing rather than causative factors has recently been supported by Marie and Roussy.[5] These men working among the wounded during the last war state that the various paralyses resulting from injuries or lesions of the cord or brain prevent the patient from changing his position as he would otherwise do and that the associated loss of sensation disparages any inclination to move. As a result of this certain parts of his body constantly support his weight and bedsores appear (Figs. 25 and 26). Especially is this true if there is an incontinence of feces or urine. In such patients it is not imperative that the pressure be necessarily very severe or prolonged to cause marked local anemia and final gangrene. Bedsores, therefore, in these patients are indeed very serious since the destruction of the tissues is so rapid and the healing power so limited.

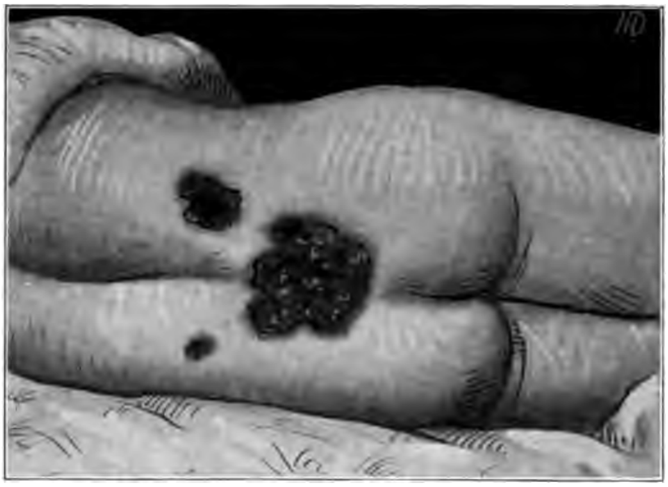

Fig. 25.—Bedsores following myelitis. (After Keen.)

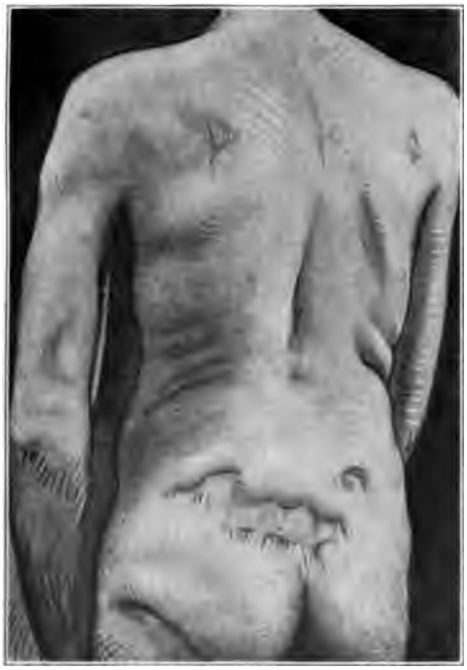

Fig. 26.—Healed bedsores. (After Keen.)

Decubitus also, is seen in patients with no cerebral or spinal affections, but in those who because of their condition are obliged to remain in bed for any length of time. The emaciated and otherwise weakened patients are more liable to this affection than those of stouter builds, although this malady may affect any patient who is in bed even for a limited time if there is too prolonged local pressure on the tissues. Thus pressure from an improperly applied bandage, splint, or plaster of Paris dressing may do untold damage within a short time if the accompanying pain complained of by the patient is not heeded.

Pressure from bed clothes, particularly over the toes, wrinkles in the sheet or patient's gown, bread crumbs, pins, strings in the bed will cause this complication.

Inactivity of the patient, excessive secretions, regardless of the nature, predispose to bedsores, especially if the skin is not kept scrupulously clean, and even then, the lesion will sometimes occur despite the best nursing.

The lesion most usually occurs over the bony prominences corresponding to the sacrum, coccyx, or tuber ischii. They occur also over the back, along the spine, on the heel, over the malleoli or point of the elbow. In fact pressure on a part of the body may produce a lesion in a most unexpected place, depending on the position of the patient. There is first a reddening of the skin which is usually accompanied by a burning pain more or less severe. Unfortunately at times, very little or no pain is complained of and the sore is found quite by accident. Following the redness of the skin at the point of pressure there occurs a bluish discoloration, probably spotted at first, which soon changes to a solid brownish or black color. Vesicles or bullæ may form here and there over the area, and these finally rupture, leaving an ulcerating surface which soon becomes necrotic. This necrosis may involve muscles, tendons, and occasionally even bones. A line of demarcation forms sooner or later, and under proper care the tissue sloughs out, the defect healing by granulation.

As a rule the bedsore does not become so extensive; an ulceration of the skin and possibly subcutaneous tissues being its extent, although in some cases destruction does not stop even at the bone but passes on into the spinal canal, causing meningitis and death.[3] That dire consequences can occur from these lesions, due to infection or extension of the process must always be borne in mind and measures instituted to combat both these possibilities as soon as the trouble is discovered.

Much has been written on the treatment of bedsores. The most important result one can hope to attain is to *prevent* them. Patients on admittance to the hospital are given thorough cleansing baths with soap and water followed by an alcohol rub (50 per cent) twice each day until the operation. This not only keeps the skin clean, but tends to harden it. They are placed in comfortable beds with smooth uniform mattresses, over which the sheets are kept stretched, and if necessary, pinned to the mattresses to prevent possible creases or folds occurring. The importance of keeping bread crumbs and other foreign particles out of the bed is self evident. The skin must be kept dry, a task not always easy of accomplishment. The proverbial rubber sheet on every hospital bed is sufficient in itself to cause some patients to perspire freely, particularly in hot weather. This should be removed in such instances and the danger to the mattress met by using strips of rubber as the occasion demands. Occasionally it becomes necessary to replace the rubber sheet with some absorbent material which will dispose of the perspiration as quickly as it forms. The value of this procedure was recently extolled by Smith[6] who though a helpless invalid was bedridden over five years without a lesion developing. In this connection we also freely use boric acid powder, equal parts of boric acid with bismuth subnitrate, or even talcum powder to dust over the body as often as necessary to keep the skin dry. This procedure is also particularly useful following the sponge bath and alcohol rub. Where there is an incontinence of urine a rubber urinal is constantly worn. When the patient is incontinent both as to the feces and urine he is washed, as soon as soiled, with warm water and castile soap, given an alcohol (50 per cent) rub to which alum, 10 grains to the pint, has been added. According to Lind[7] this is repeated after every soiling, and if there is any redness of the skin in the regions repeatedly soiled he would apply zinc oxide ointment (U. S. P.) I have found that a mixture of the above zinc oxide, one ounce, cotton seed oil, two ounces, and alcohol, two ounces, is an exceedingly good application for these cases. In fact this mixture may be used twice daily over the whole body in patients not so affected and in every instance with the most satisfactory results. It is usually rubbed into the skin morning and night immediately following the bath.

The Bradford frame is very valuable in paralyzed patients or those suffering from fracture of the hip. Such patients placed on this or some similar device can be turned at will and any pressure points relieved by treatment.

In studying the various methods to keep the skin in a healthy condition locally, one must not forget that looking after the general condition of the patient is equally important. His general health is carefully watched over and an abundance of food supplied.

If this complication arises in spite of every measure skill and common sense can devise to prevent it, one must first invent some means to relieve all pressure and tension from the affected part. Air cushions, rubber rings or even a pneumatic or water bed have been employed for this purpose. For those patients greatly emaciated or paralyzed, such beds are indeed valuable in bringing about an equal distribution of the weight. However, these are not always to be had and under such circumstances the mattress may be replaced by a bed of some airy soft material such as cotton, wool or hair, which is thrown loosely into an improvised bedstead. Zweig[9] employs wood wool, the patient being allowed to lie on the loose material which has no covering at all and is confined by the limits only of an old-fashioned wooden bedstead. This maneuver, to be sure, is not always agreeable, but may be employed in extreme cases. Pressure from bedclothes or irritation from the night gown is overcome by the use of cradles, wire cages, and even the application of absorbent cotton[8] placed over the lesion and held in position with collodion is very advisable in some instances.

Very small breaks in the skin are often protected by simply applying an ordinary zinc oxide adhesive strip directly over the exposed surface. Where the lesion is so large that neither of these remedies is advisable, the part is kept clean with a saturated boric acid solution or sterile water, and then dusted with boric acid powder. Lind recommends for this purpose aristol one part, boric acid one part, and lycopodium eight parts. The wound is left open and exposed to the air, this portion of the body absolutely relieved of pressure.[10]

Bedsores which involve the deeper tissues require more extensive treatment. In such instances the electric light treatment is instituted. The lesion is kept free of crusts, sloughs are pulled off whenever it can be done without bleeding, and the tissue irrigated frequently with Dakin's fluid, boric acid or hypertonic sodium chloride solution. At night a 4 per cent boric acid ointment is placed in the defect and the whole covered lightly with gauze or else a small wire sieve fastened over the part by means of adhesive. The use of adhesive is not desirable[11] in every case as it is very irritating to the skin of some of these patients and in selected cases only is it to be desired even for this simple means. The next morning the ointment is removed lightly with gauze and the electric light treatment resumed.

In cases where this treatment is not practical in the usual way the rays of light may be directed into the lesion by means of a concave head mirror. Whenever it is possible to substitute sunlight for the electric light these rays are directed into the wound in this same manner. This was first suggested by Ring.[12] It is remarkable how quickly such lesions heal when all the details of this treatment are persistently carried out.

Decubitus of long standing and which show little or no tendency to heal may be stimulated with alternate hot and cold compresses. The granulations be stimulated by rubbing a silver nitrate stick over the surface occasionally. Massage of the adjacent skin is also a valuable procedure. At night the boric ointment is replaced. A mixture advised by Lind follows: silver nitrate one part, balsam of Peru ten parts, zinc oxide ointment one hundred parts, or the balsam of Peru may be used alone. When the granulations have become even with the skin surface, 4 per cent scarlet red ointment replaces all other ointments and the light treatment is continued.

Multiple bedsores particularly in emaciated or paralyzed patients may require a continuous full warm bath at a temperature of 95° to 100°.[13] The treatment may be kept up as long as desired without appreciable weakening or injury to the general health and when there is marked improvement in the lesions, they are then cared for as suggested above.

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CHAPTER XXI

POSTOPERATIVE PROLAPSE OF ABDOMINAL VISCERA

By Willard Bartlett, St. Louis, Mo.

Professor Madelung's exhaustive article with its 105 literature references which appeared in 1905, leaves absolutely nothing to be desired so far as this subject is concerned, hence I feel that I can do my readers no greater service than to present a painstaking abstract of it as a chapter on this subject. Madelung[1] up to 1905, was able to find 144 cases in the literature, had 7 in his own practice, and 6 in the practice of several of his colleagues, thus making 157 cases for purposes of study. The accident has occurred after exploratory laparotomies where no decrease in the abdominal contents was made, but what is much more surprising, it has also been noted after removal of the largest tumors. It occurred in the earliest days of abdominal surgery, in 1844 for instance, as well as in most recent years with all the modern improvements. It has occurred in a child two days old and in a woman seventy-one years old. In women it occurred 118 times and in men 25 times, while the sex is not given in 14 instances. Practically every form of abdominal and pelvic operation has been complicated in this way. One hundred twenty-four times the incision was in the lower half of the abdominal wall, while in 16 instances it was in the upper half, and it has been much more common where the incision has gone directly through the midline rather than through one of the rectus muscles. The danger of this accident seems to be especially great when the incision goes through an old scar as noted by Spencer Wells in 1863.

As to the time when the wound is most likely to burst open, Madelung concludes that this is somewhere between the eighth and ninth day. (It should be noted that the date of occurrence can not always be given since in many instances it was discovered by accident.)

In most instances the entire length of the wound was found open. In a very few interesting cases the viscera did not come out through the original incision in the muscle but through a fresh tear in this tissue. With the exception of the spleen and pancreas, every abdominal viscus has been prolapsed in such cases. The most frequent of them is the small intestine, with the omentum in second place. In many cases the viscera simply lie between the wound edges without being pushed outside the skin level. This was accounted for, no doubt, by fibrinous peritoneal adhesions; often, however, the prolapse was of tremendous size. The condition of the mass has varied with circumstances; incarceration of the intestine being reported only once. It is interesting to relate in studying the etiology that this unfortunate accident occurred most frequently where silk-worm gut alone, silk alone, wire alone, or all of these suture materials combined, have been used. It occurred where layer closure, as well as "through-and-through" sutures were used. In one instance, the intestine slipped out between two through-and-through sutures which had been placed rather far apart. Of course it has occurred where catgut alone has been employed, but Madelung after his extensive study of the subject considers it wrong to conclude that any special suture material or any one suture method protects against bursting of the wound. It was once thought that the too early removal of sutures accounted for it, but the statistics do not bear out this conclusion, since it has often occurred before the stitches were removed. On the other hand, it must be admitted that the wound burst thirty-nine times within twenty-four hours after the stitches were taken out. It has occurred, however, as late as the seventeenth day in a patient whose stitches had been removed nine days earlier. It does not seem to have been caused by leaving a small portion of a wound open for drainage, nor does tamponade seem to have had this effect. (It would seem, then, that the cause of this distressing accident must be sought elsewhere than in the original treatment of the laparotomy wound.)

An important causal factor is to be sought in the condition of the abdominal wall. There is danger where it is very thin, especially in a greatly weakened individual or in one who has been starved. Bleeding between the layers may be a causal factor, as may be localized infection. In most instances, however, wound healing would appear to have progressed perfectly up to the moment bursting occurred.

Coughing is surely one of the chief causes of this condition. In 51 out of these 157 cases, it seems to have been chiefly to blame, while in the second place, must be mentioned vomiting, which was the direct cause of the accident 26 times. In some instances the two last-mentioned factors worked together. Straining at stool is mentioned five times in this connection and tympanites seem to have played a minor role, surprising as it seems. Rapid increase of intraabdominal tension in pregnancy, ascites, and the growth of abdominal tumors has, in a few instances, been responsible.

It is curious to study the patient's sensations at the moment the abdomen bursts open and to note that they are frequently far from what one would expect. Very few have expressed severe pain or a characteristic feeling of bursting. They have complained rather of general abdominal discomfort and frequently has this been so light or disappeared so quickly that the patient has forgotten to mention it at the time to a nurse or doctor, but has recalled it hours or days later when the prolapse is discovered. Frequently, the first sensation has been that of something warm and moist on the abdomen and thighs. In many instances the most acute questioning has failed to bring out the fact that the patient's attention was ever attracted by any unusual sensation at all. In rare instances, the patient has complained of "feeling badly" or shown general disturbances with collapse symptoms, etc. As a rule, the general symptoms have remained good throughout, while the occasional patient has expressed the feeling of great relief when the stitches gave way. In most cases the accident has been discovered by observing the changed appearance of the dressings. They have been soaked with fluid or bulged to the extent that an examination has been made and the viscera discovered outside the abdominal wall. There can be no doubt that hours and even days have elapsed before many of these patients have come into the surgeon's hands. This is especially true where old thin scars have ruptured. How ridiculous it seems, then, to operate on the patient in his own bed with a show of haste, instead of getting him into proper surroundings. A general anesthetic has been used many times, though it is not at all necessary. When there has been a fecal fistula or suppuration in the wall, etc., careful cleansing of the bowel is necessary. Where an aseptic dressing has covered unsoiled viscera, cleansing is unnecessary and may do harm. Shall we then replace the viscera at all or shall we do it at once? Of course the ideal treatment is replacement with immediate suture. In some instances, however, it is not possible to get the prolapsed contents back into the cavity, and in seven of the cases reported, no attempt at reposition was made. In quite a number of instances this was accomplished, but sutures were not inserted, at least not early in the treatment. Both of these acts were frequently prevented by coughing, meteorism, adhesions, etc. It is worthy of mention that spontaneous reposition took place in the course of weeks or months in those patients who could not or at least who did not have the benefit of this maneuver. In no single instance did the prolapse persist, whence conclusion should be drawn that we must not too hurriedly puncture or resect intestines which we can not replace.

Prolapsed omentum can be amputated without any further consideration. It is of great help frequently to place the patient in the exaggerated Trendelenburg position, while at the same time the edges of the wound are held up and slight pressure exerted on the viscera. It is often necessary, in addition, to extend the original incision as well as to separate adhesions between intestinal coils or between them and the abdominal wall. This produces little or no pain, hence it is necessary to use an anesthetic in especially difficult cases only. In fact, a really sensible patient can aid the procedure greatly by his voluntary efforts. Sometimes a second attempt succeeds after the first has failed, hence the operator is not to give up after a single trial. Some are in favor of freshing the wound edges in the customary manner before suturing is attempted. This latter procedure is sometimes exceedingly difficult; the tissues may be friable and the sutures may cut through or it may be impossible to approximate the edges so that gauze must fill out the defect. Of course every form of secondary suture has been used in these cases but apparently one method is about as good as another. In many of the cases where reposition has been made without suture, tamponade has been resorted to.

The direct consequences of treating this condition as outlined above have been astonishingly slight and the bowels have moved as though nothing had happened. In a few instances, however, hasty attempts at reposition have been attended with serious consequences. Intestine and bladder have both been injured by a rough attempt at treatment. In quite a number of cases, secondary prolapse has taken place though not so often as one would expect, when the original method of treatment is considered. Peritonitis has developed in astonishingly few of these cases. The most frequent complications to arise have been those affecting the respiratory system. (No doubt this is in some measure accounted for by the fact that secondary sutures have been supported for a long time by adhesive straps, binders, etc., which have interfered with free movements of the lower ribs and diaphragm.—Author's note.)

The prognosis in such cases does not depend upon the kind of viscera prolapsed, or upon the size of the mass, or upon the time which has elapsed before treatment is instituted. One hundred five of the 148 patients whose result is known were reported as completely cured. The scar deserves special mention. It must have been a satisfactory one, since no mention was made at all in most of the histories. It is reported 18 times as having been a perfect one after many years, while it is definitely stated 11 times that no hernia occurred. This is even true in cases of multiple ruptures even though no suture was employed.

In one case the same wound burst twice, the first time in consequence of heavy lifting and the second time two years later (Synak). The bursting of healed laparotomy scars is reported in 16 women and 2 men. In all of these, a most unusual thinning out of the scar had taken place. There seemed to have been very little cause known for this bursting, the patients were surprised and in fact, it occurred twice during sleep. In a few cases, however, there was a slight strain, such as sneezing, coughing, bowel movement, lifting of a weight or jumping from a height. The patient had become aware of his condition, only upon feeling something soft, warm, and moist on the abdomen and thighs. Usually, the tear was of short length, but at times, the amount of prolapsed viscera has been enormous. The prognosis in these instances of remote prolapse must be surprisingly good, since not one of the 18 patients died. All of these patients were sewed up, but two, in whom tampon was resorted to. No recurrence took place, and in only one did hernia appear.

In only one of the 157 cases is a hernia of such size as to require operation, reported. Impairment of intestinal function was reported only once. It must then be concluded that very little remote trouble is to be expected by the individual who has sustained this accident, as a consequence of his rather horrifying experience. A critical survey of these 157 cases would indicate that immediate death was caused by the accident only 29 times.

(The author of this chapter has been so unfortunate as to have experienced this embarrassing complication seven times. All were clean cases in which reposition and secondary suture within a few hours were carried out without great difficulty. All the patients, with but one exception, were taken to the operating room and completely closed up with through-and-through sutures, ether being used only once. The other six closures were accomplished with seemingly very little pain in the absence of even a local anesthesia. This we credit to very gentle manipulation and the use of exceedingly sharp cutting needles, of the Reverdin type.)

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CHAPTER XXII

FOREIGN BODIES LOST IN THE PERITONEAL CAVITY

By Willard Bartlett, St. Louis, Mo.

Sir John Bland-Sutton once said, in his inimitable way, "before closing the abdomen count your sponges, instruments, and assistants."

It is really surprising that our horror at accidentally leaving foreign substances in the peritoneal cavity or other tissue spaces did not long ago influence us strongly against permanently embedding them as supports, splints, etc. It is only within more recent times that the marked reaction has come against the employment of anything other than structures of an autoplastic nature in the process of surgical reconstruction.

All of us, who have embedded Lane's plates, or other nonyielding foreign substances, know perfectly well what an extensive bone atrophy takes place in their vicinity. The same thing holds good, in a lesser degree of wire sutures, and all the other multitude of nonyielding foreign bodies, which have from time to time been employed with design. Indeed, the greater majority of surgeons, the writer included, go so far as to shun the use of permanent suture material of any kind in a region from which it can not be readily removed, either by nature or the human hand.

It is with no little chagrin that a surgeon confesses to having left foreign bodies in the peritoneal cavity by accident, and when one realizes that such case reports are not published voluntarily in a majority of instances, he is prone to conclude that the accident is far more common than we have usually supposed. No doubt, many an individual has lost his life in consequence of this accident, hence, the number of reported instances grows relatively less in the light of such reasoning.

Neugebauer[1] has done more than any other writer to attract the attention of the profession to this matter. His study of it came about as a result of his being called upon to make statistical studies, which were used in the defense of two brother physicians, who were accused of this dereliction. The case in question is so instructive, and in many respects so dramatic, that it is quoted in some detail by excerpts taken from Schachner[2] (whose article is worthy of complete perusal by those especially interested in this subject).

"Professor Kosinski performed an abdominal section upon a patient fifty years of age, for an ovarian cystoma with a twisted pedicle. The operation was very difficult on account of numerous adhesions and an interrupted narcosis.

"After the first few days an elevation of temperature occurred, accompanied with abdominal pains and pains in one leg. An inflammatory infiltrate was felt. By this time it was discovered that two artery clamps were missing from the instrument cabinet. It was thought that the artery clamps might have been taken by Dr. Solomon, as he had left shortly after this operation to perform another in one of the provinces. Nevertheless, the coincidence aroused the suspicion of Dr. Kosinski, that perhaps the missing clamps had been left in the abdomen.

"Consequently, six weeks after the laparotomy, he reopened the abdomen to investigate the infiltration, but found neither pus nor the missing clamps. His suspicions were not allayed. However, he concluded to wait for further developments. The condition improved after the second abdominal section, although there remained a fistula, which finally closed.

"Several weeks passed, but as the convalescence seemed to be retarded, Dr. Kosinski was again called for a more thorough examination. On this occasion, he felt a hard resistance in the region of the umbilicus. Per rectum and per vagina there was nothing to be felt. His former suspicions were renewed, and he expressed them to the family, stating that perhaps the hemostats that were missing from the cabinet had been left in the abdominal cavity.

"Professor Kosinski insisted that another operation be undertaken and offered to perform the same gratis. The patient had agreed and a room had been prepared for her, but she failed to appear. The family physician had informed her two sons of the nature of the operation, to which they failed to give their consent, as they stated they had lost all confidence in Professor Kosinski.

"The patient was sent to the health resort, Ciechocinek, with the view of promoting the absorption of the inflammatory exudate. She improved to such an extent that when her sons told her of the suspicion of Dr. Kosinski, she would not believe it and ridiculed the idea.

"Six months after the first operation, the patient arrived at Warsaw from Ciechocinek. Before the arrival at the station, she reached up to get some baggage, and at the same moment, suddenly became faint. The momentary shock soon passed and on reaching home, she entertained her sons until late at night. On the following morning, she felt extremely weak, and Dr. Frankel was called in, who demanded immediate operation by Professor Kosinski, and told her sons that no time should be lost. They refused to call Dr. Kosinski, but called in Professor Wassiljew. The latter saw the exhausted patient about midday, and was told of the suspicion of Dr. Kosinski. In spite of the fact that the patient had passed by rectum in all, a vessel full of blood clots, the professor suggested that a radiogram be made, and the patient was removed in a drosky to an infirmary, where she was led up three steps and remained several hours. Several radiograms were made, but with negative results. The exhausted patient was taken to her home late at night, and the following morning, Dr. Wassiljew, assisted by Dr. Krejewski, performed the abdominal section. Partial narcosis was used, and the patient became almost pulseless. The Douglas pouch was found covered by inflammatory bands. A second oblique incision was made above Poupart's ligament, hoping to reach the seat of disturbance extraperitoneally. A large cavity was opened, in which both hemostats were discovered, lying parallel and just above the pelvic brim. Both forceps had forced an entry into the left external iliac artery. The removal of the forceps was attended with a furious hemorrhage, which the operator endeavored to control by compressing the aorta. The cavity was tamponed. The patient died upon the table.

"The ends of the forceps had punctured the left external iliac artery, when the patient reached up to get her baggage at the railway station. A false traumatic aneursym had ensued as the autopsy showed. The lower end of the forceps had perforated the large intestine and this accounted for the blood passing from the injured artery by way of the rectum. Had the operation been performed when the patient left the railway carriage, or even on the following morning as the family physician had requested, perhaps there would have been a recovery.

"The patient, who was suffering from an injured artery, was driven in a carriage to her home; from there to an infirmary, then marched up three steps to have a radioscopic examination made, with unsatisfactory result, as it appears, owing to imperfections in connection with the outfit. After the unsuccessful attempt, another twenty hours had elapsed before the operation was performed.

"The trial lasted four days. There were six experts, two who had made the postmortem examination, to judge the pathological-anatomical side.

"Neugebauer supplied the statistics that were likely to be called for in the controversy. Professor Pawlow, of St. Petersburg, under-took to depict what is called a coeliotomy, and the complications and mistakes that are likely to occur.

"Summary:—The direct cause of death in this case was the perforation of the artery by means of the foreign body. The indirect cause, the refusal of the sons to comply with the request for another abdominal section by Dr. Kosinski; and the loss of time that arose from the trip to Ciechocinek. The trial ended in the acquittal of the accused."

A rather striking instance of a similar nature occurred many years since, in the practice of a distinguished St. Louis surgeon. He had operated on a gentleman, who had left the hospital in a reasonably good condition, and not having reported since that time, his satisfactory convalescence had been taken as a matter of course.

A few months later, the surgeon was in his office one day, when this patient walked in, presented an artery forceps, with the inquiry, "Is this yours?"

"Of course it is, it has my private mark on it," replied the surgeon.

"That is all I wish to know," the patient said. "It was taken from my abdomen some months after I left your service."

In order that there might be no misunderstanding of the patient's intent, he had brought along his legal adviser for the interview, which did not end until a financial arrangement had been consummated, of a nature so satisfactory to all concerned, that the incident never found its way into court.

I was consulted not long since by a gentleman who had an intermittent biliary fistula. He gave a history of two surgical operations; at the first one gallstones had been removed, although neither procedure had succeeded in relieving him of his symptoms. He was not exactly sure what had been done, nor could we get the technical details of the previous operations, since my confrere had permanently left St. Louis.

Upon opening the abdomen, a large gauze pad was found, occupying a space between the stomach, colon, and under surface of the liver, a site which the gall bladder must have formerly occupied. and into which bile was welling up from below, there being a communication with one of the ducts. The patient stated that his second operation had been of a minor character, and had not at all modified the course of his malady, and it had seemed unsatisfactory to the operator, hence, one is prone to speculate on the interesting probability of the surgeon having left the gauze pad at his first operation, and totally overlooked it during the second performance. It must be very rarely the case that a foreign body left at a first sitting is not removed at the second.

I remember very well the first time I ever detected a foreign body which had been left in the abdomen by accident. A colleague requested me to explore one of his patients for a very ill-defined symptom-complex, which had followed an operation on the pelvic viscera. We were both surprised, and my colleague greatly embarrassed, by finding a very large gauze pad, tightly encapsulated between intestinal coils. The interesting thing about this case, and the reason for quoting it is that it exemplifies in no uncertain way, nature's method of spontaneous relief, which must be rather frequently afforded such patients. There was no mistaking the fact that one corner of the thick gauze pad was drawn out and twisted into a conical mass, of which the distal six or eight centimeters were smeared with feces. Upon further inspection of the wound, we found that this gauze cone had been withdrawn from an opening in the intestine into the lumen of which viscus, the gauze was gradually being drawn by peristaltic activity. No doubt, in the course of time, the newly formed cavity, in which the pad lay, would have been emptied and its walls collapsed; then had the foreign body not obstructed the intestine, it would have eventually been passed out the anus, and quite possibly, never been noted at all by the patient.

To one unfamiliar with the subject, this may serve as a striking example of the fact that nature is sometimes more generous to us than we have deserved, in the after-treatment of surgical patients.

Almost any surgeon of experience has had his attention attracted to these cases, but no doubt, all of us will be surprised to read for the first time, that Neugebauer[3] claimed that in 1907 he had collected 236 authentic records of this sort. More recently, Crossen[4] published a list of 240 such cases, and he surprised us all the more when he stated that about one-fourth of these individuals died as a result of these accidents. As most of us would suppose, from our limited experiences, a gauze sponge was the article most frequently left behind, although the offending matter was a forceps (Fig. 27), or some part of another instrument in about one-fourth of all such reported instances.

It must be that parts of needles are very commonly lost in the peritoneal cavity. All those who have had experience deep in the pelvis, know that needles not infrequently break, and occurring as it does, when a part of this small instrument is imbedded in the tissues, one readily understands that a fragment is recovered with the greatest difficulty.

I know a number of operators who have had this unfortunate calamity to befall them, and I do not recollect one who is given to careless practices, hence, it must be that this accident is rarely the result of carelessness, or to a lack of some system, calculated to prevent just such happenings. One is, therefore, prone to analyze the various instances in which the accident has taken place, and if possible, to formulate some general rules which may call attention to the reasons they occur.

In one case, extreme *haste* seemed necessary in the removal of a gangrenous, perforated gall bladder, to the end that gauze packing was placed and supposedly removed, with consideration for only one prime necessity: viz., that the patient must be returned to bed before it was too late. In this instance, a gauze pack was left behind and removed some months later, so it will be noted that foreign bodies are likely to be lost in those operations attended with rather unusual haste.

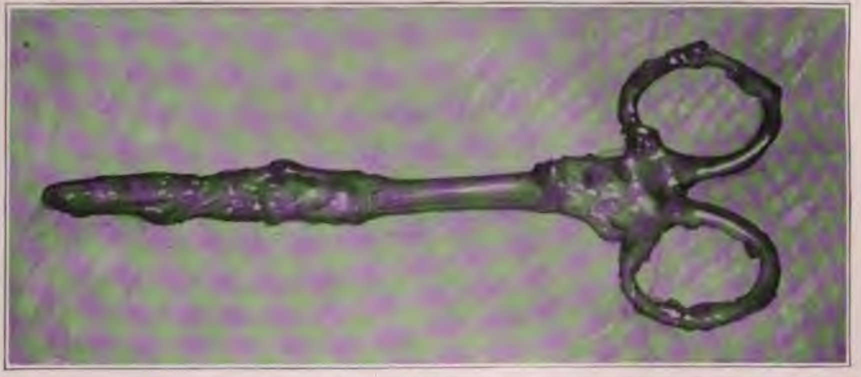

Fig. 27.—Rusty forceps removed from abdomen at a remote period. (After Keen).

In another instance, a furious *hemorrhage* from an unseen cause, complicated a splenectomy, and several packs were thrust into the cavity from which the blood came, the field being more or less obscured by it. The abdomen was hastily closed, and when all packs were removed a few days later, one was accidentally left behind, producing a decubitis of the stomach wall, and a gastric fistula, which resulted in the starvation of the unhappy individual. It will be seen, therefore, that hemorrhage is another of the factors which may lead to this undesirable accident.

It may be mentioned in this connection that men who work in a large *number of hospitals* are more likely to expose their patients to this accident than are those who follow the single routine, which is possible under one roof. Every hospital has its particular plan for avoiding this mishap, and every operator must, as a matter of course, conform to it, hence, the conclusion is obvious that a man who works in many hospitals and employs many methods, some of them at rare intervals, is particularly likely to experience this accident.

It must be noted in passing, that foreign bodies found in the abdominal cavity do not necessarily mean that some surgeon is to blame. Green[5] reported a case in which a bone crochet hook, 4½ inches long, was found at operation within the layers of the mesentery of the colon. The patient, eleven days before, had inserted this instrument into the uterine cavity, in an effort to induce menstrual flow, and during the effort had lost it. The symptoms were nil save for slight pain when she moved. The hook had evidently penetrated the soft uterine wall. Schachner[6] also reports a case in which gauze was found to have been discharged through an abdominal abscess. The woman was insane and had been in the habit of swallowing strips of cloth. No previous operation had been performed and it was thought that the cloth had ulcerated through the wall of the stomach.

The **Final Disposition** of foreign bodies in the peritoneal cavity has been referred to in one case of the author, where extrusion into the intestine was found in progress. This is probably the most common fate of all such bodies, provided the individual lives long enough for its accomplishment, and no secondary laparotomy be attempted. We can imagine certain absorbable substances, which are eventually taken care of by phagocytic action. In other instances, the suppurative and destructive process may become so extensive that a foreign body is extruded through the abdominal wound, or if it has firmly healed, the offending mass is forced out of the abdomen through the segment of the abdominal wall, which offers the least amount of resistance to its passage. In other cases, pointing into the vagina has been reported, and in at least one reported case, a forceps found its way into the patient's urinary bladder.

Symptoms.—The symptoms of foreign bodies in the abdomen are indeed varied, and frequently simulate other conditions. There may be none at all, and again, the most violent intraabdominal disturbances may follow. Much depends upon the character of the object, its location, and the resistance of the individual, in addition to the all important point of asepsis mentioned in the foregoing.

The reason for a second abdominal section is usually a persistent fistula, but it may be brought about by symptoms which threaten the life of the patient. The foreign body may cause a dull, aching pain which is constant, and more or less localized. The presence of a tumor, at times freely movable, which in outline resembles the foreign object, may be seen. The peristalsis is apt to be much disturbed, and the whole clinical picture may be that of intestinal obstruction. As mentioned before, a violent sepsis may quickly develop, or as Schachner[7] has aptly said: "The case may drag along with symptoms of more or less pain, or a sense of uneasiness, elevation of temperature, emaciation, sweats, and in fact, the usual course of a mild but protracted form of sepsis."

The symptoms alone are not a safe guide in these cases, and in every instance they must be backed with thorough *physical examinations.* In many cases, the objects were palpated through the rectum, vagina, and through the abdominal wall. The x-ray is valuable, although in Kosinski's case, the instruments did not show, due to faulty technic.

Pelvic or abdominal abscesses, and fistulæ which can not be explained, should be looked upon with suspicion, and special attention given to the possibility of a foreign body. Such cases require diplomatic handling, and no word or expression should ever reach the patient, which would in any way communicate the surgeon's suspicions to her.

Prognosis.—The prognosis in these instances varies greatly with the character of the foreign body left, the locality in which it lies, the resistance of the patient, and the incidence of early diagnosis. It is quite probable that a yielding substance, like a small gauze pad, may lie undisturbed for many years, provided only that the cavity in which it becomes walled off by connective tissue, has adequate drainage into a viscus or onto the surface. Of course perforation of an important hollow viscera, to which reference has been made in the preceding paragraphs, is by no means innocuous; then again, there is no telling when an unyielding foreign body may cause perforation of a large blood vessel, with consequent fatal hemorrhage, hence it will be seen that prognosis is an individual matter to be determined in each case on its individual merits.

Prevention.—Prevention is the watchword in this connection. One of the earliest means of preventing this accident was to place a number in a prominent place on the sponge going into the abdomen. In 1900, Kelly[8] devised a sort of a metal rack for these objects, but in common with every one else, gave it up before he had used it very long. Fisher[9] employed a tape about four feet long, on which a heavy needle was threaded. As each sponge was put to use, the needle was passed through it, and thus all the sponges threaded on the tape. Carson,[10] of St. Louis, used to attach to the corner of his packs, metal rings so large that they could hardly escape attention and be carried into the abdomen. Others have used large rolls of gauze in packing off, large portions of the material being left outside of the cavity, in an effort to prevent the loss of that which was employed within it. At one time, simple counting of all gauze packs was rather frequently resorted to, although this can not be said to have been a marked success. In more than one instance a miscount has been reported after closure of the abdomen, then a reopening made and a fruitless search, after which, the supposedly buried pad has been found on the operating room floor.

A surgeon in one of our St. Louis hospitals, hoping to obviate the danger under discussion, formed the habit of employing large towels for the purpose of packing off hollow viscera, but he gave this up after returning to the hospital, following an absence of several days, to learn that his house surgeon had relieved a case of intestinal obstruction by removing one of these towels some days after the original operation.

A most reasonable proposition in this connection is to employ a very long strip of dental rubber dam for abdominal wounds. This could hardly be overlooked and lost, especially if a generous supply of it were left outside the peritoneal cavity and anchored to the table coverings.

Crossen[11] uses a ten-foot continuous roll of gauze, 25 mesh to the inch. "Each strip is packed into a separate cloth bag, five inches wide and ten inches deep." The end of the strip which is introduced first into the bag is sewed securely to the bottom. To this region, also is attached a safety pin for fastening the bag to the sterile sheet. An apparatus to hold both wide and narrow strips is described by this author in detail. "From 48-inch heavy duck, a piece 26 inches long is cut. This is divided in half, giving two pieces, each 24 by 26 inches. Beginning at the selvage edge, a triangular piece, 2 inches wide at the top, and running out near the bottom, is cut off from each end, giving the pieces shown in the figure, which is 24 inches long, 26 inches wide at the lower edge, and 22 inches wide at the upper edge. The lower edge is hemmed, giving three thicknesses. This stiffens the edge, the piece is then folded, bottom to top, and the raw ends bound with tape as they are stitched together so that no ravelings can be exposed. The front edge has been stiffened by the hemming and it is four inches longer than the back edge, hence the bags stay open. It is next stitched down the middle, so as to form two large pockets. Another bag is then made just like the first one, except that one of the large pockets is stitched down to the middle, so as to form two small pockets. The two bags are then fastened together with 2-inch belting, leaving 8 inches between. The end of a narrow strip is carried to the bottom of a narrow pocket and fastened there, as indicated by the black stitch. The strip is then packed. The other narrow pocket is filled in the same way. The wide strip, folded as in the figure, is laid in a wide pocket of the other bag. The bags are then sterilized."

At the operation following the placing of the towels, and finally the sterile lap-sheet, the apparatus as above described, is placed over all across the abdomen. The wide strip may or may not be soaked in sterile salt solution, but in either case, it is fastened to one of the cross straps by means of the tapes which are attached to the end of the wide strip for this purpose. No strip, under any circumstances, is cut or detached, the soiled portions being placed in the opposite side of the bag, which has been arranged for them. The first case of a foreign body left in the abdomen, following the use of this contrivance, is yet to be reported.

The method which I have employed for many years is perhaps the most commonly used, and has at least in its favor the fact that almost every one is familiar with the method, which consists in the use of a gauze square, to the corner of which a tape has been firmly sewed, this latter to be anchored to the table covering by a heavy forceps. Fortunately, no plan of packing off is simpler than this, but it has two serious objections to its use. (1) All forceps will be found to wear in the catch and come loose at the least expected time. (2) An assistant is very apt to remove any forceps in sight, and may therefore, take one off such a tape when the supply gets short, as it does in some long-continued operation, or when a sudden need presents itself.

My own conclusion as to the usefulness of a method is simply this: every operator finds the procedure with which he is most familiar to suit his needs, and I should, therefore, recommend that he continue to use any one which is found to give him immunity from the accident under discussion. The one I am accustomed to suits me extremely well, although I must admit that many a man in whom I have confidence, utterly refuses to have anything to do with it, and no doubt he is right according to his lights. It must be stated, before closing the paragraph on prevention, that no means at our command, with possible exception of the one devised by Crossen, has prevented this lamentable happening, and if it be true that history repeats itself, we must take a rather somber outlook, so far as this phase of surgery is concerned, and neglect no precaution which is within the field of human possibilities.

Treatment.—The treatment of foreign bodies, which have been accidentally left in the peritoneal cavity, consists, of course, in their removal as soon as discovered. I am sure no one would hesitate to do this before the patient has left the table, at the original procedure, provided discovery were made at this time. The matter of treatment, as it affects the special viscera, which have been involved in the numerous instances cited, must be left for a consideration special for each case.

The *operative technic* requires for its successful consummation, something which may, for want of a better term, be defined as intuition. The surgeon, who has once removed a gauze pad from a wound will never forget the peculiar tactile sensation this imparted to the exploring finger. Unfortunately, it can not be described, but must be acquired by practice. To confirm the finding, tear off a raveling with a forceps, then attract the attention of onlookers to something outside the window, cover the field with a towel, and proceed to deliver the offending object.

It is hardly fair to surgery that this subject be dismissed without at least a reference to the *malingering* which is possible in this connection. Porter,[12] from whose own words I shall quote liberally, gives an interesting example of a type of patient against whom the surgeon must be constantly on guard.

An operation had been performed for parovarian cyst, hydrosalpinx and chronic appendicitis. The patient had been discharged from the hospital twenty-two days after the operation. The convalescence had been normal. Porter, after eight days, was informed by the family doctor that he had removed several pieces of gauze from her vagina. "Upon inquiry from him," says Porter, "I learned that the pieces were removed with forceps, in the shape of rolls about the length and size of a lead-pencil, and after all presenting were removed, others would present in a few hours, and he thought they came through an opening in the right side of the vagina, about the size of a lead-pencil.

"I visited the patient at her home with her doctor, and was shown a large number of pieces of different textures, whereupon, I remarked that the goods were not such as I used, all told, in the operation, and that consequently they had not been left in the woman's belly by me. It was averred that they could get into her belly only through the wound made by me, and at the time it was made, because it had been closed, healed by first intention, and was still closed. The patient facetiously remarked that she supposed she swallowed them. 'No,' I replied, 'had you swallowed them, they would not come out through the vagina.' "

"Dr. F. now asked the patient whether she thought more pieces were coming down, and being answered in the affirmative, he introduced a speculum and found that she was right. I removed the speculum, and introduced my finger, which came upon a small wad of something, which upon removal, proved to be a piece of ordinary muslin about three inches wide by seven inches long, twisted into a rope, and doubled upon itself so as to make a small ball or wad. It was perfectly clean and was so saturated with what looked and smelled like urine that on squeezing between the fingers, several drops were squeezed out. I examined the vagina with my finger, assuring myself that there were no more pieces there, that there was no hole leading into the pelvic cavity, and that, in fact, it was a perfectly healthy vagina, and in no wise unusual except its cleanliness, for which, of course, the frequent wipings it received were accountable."

In regard to the possible cause for the deception, Dr. Porter mentioned: 1. Desire for money. 2. Desire for sympathy. 3. Desire to avoid work. 4. Sexual perversity.

Full credit is due O. F. McKittrick for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER XXIII

FISTULÆ

By Willard Bartlett, St. Louis, Mo.

A fistula is an artificial channel which connects a gland, duct or viscus with another one of these three, or with the outer world. The importance that this lesion occupies in surgery is well shown by the fact that the Index Medicus, for the last three years, listed a total of sixty-six varieties. A few appeared under two different captions, however, and not nearly all of them followed surgical operations, hence, only the following varieties will be considered at this time.

Internal fistulæ have connected up the viscera, two or more at a time, in an almost inconceivable variety of combinations, while the external variety have presented surgical problems which have, in some instances, baffled the most experienced and painstaking operator.

It may be said in general that the prognosis of a fistula is governed by several considerations. Perhaps the first and most important of these is obstruction to the normal outflow of material which is escaping by the artificial channel. Every surgeon of experience has drained an obstructed intestine and seen the artificial fistula remain open as long as needed, and then close spontaneously as soon as a mechanical obstruction lower down in the canal was overcome. The length of a fistula has very much to do with its spontaneous closure. A short, wide canal gives an exceedingly unfavorable outlook, while a long, narrow one, other things being equal, is distinctly more likely to close of its own accord. The mechanics which underlie these two probabilities are self-evident. The character of its walls has much to do with the natural obliteration of one of these tubes. It stands to reason that the walls of a rigid tube can not collapse as a consequence of pressure from the outside, therefore, one of this character must often be excised *in toto* before anything can be accomplished.

Treatment.—Regarding the treatment of such conditions, it may be said that stimulation by chemical or mechanical means tends to a favorable end. Nitrate of silver, Beck's bismuth paste, and many other agents which come under the former heading, have given excellent results in isolated instances. This presupposes, of course, that there is no obstruction also the presence of no foreign body. The curette has played a very important role in the mechanical stimulation of these canals, while an ingenious proposal which emanates from Dr. Hugh H. Young,[1] is the introduction into a bladder fistula of a screw in the ordinary manner, i. e., by rotating it, followed by direct extraction in the manner one draws a nail; it is attended with no uncertain degree of stimulation.

Before any form of surgical operation is attempted, it is good policy here, as elsewhere in the body, to improve tissue conditions as much as possible. If a thick-walled fistulous tract is to be excised, and is too tortuous to be threaded onto a probe, the procedure may be wonderfully facilitated by first staining the canal with methylene blue, after which it is not at all likely that the surgeon will lose his way.

Digestive Tract.—Fistulæ of the *mouth* and *pharynx* have occasionally been produced accidently or intentionally after the removal of the various tissues which enclose these cavities. It is surprising to see how quickly and how satisfactorily these will close up, or at least will shrink to proportions which render their closure a matter of simple plastic surgery. A due regard for the patient's posture enables feeding to be continued under such conditions, especially if liquids be given through a tube introduced deeply into the pharynx.

Esophageal fistulæ are exceedingly rare, though most distressing when they do occur. They are highly dangerous on account of the loss of food which is inevitable. I know of a combined esophageal and tracheal fistula being caused by a goiter operation. The unfortunate patient died at the expiration of ten days, as a result of starvation and exhaustion.

A consideration of *stomach fistulæ* brings to mind the fact that the most common internal one is that which is produced by pyloric obstruction, when a gastroenterostomy is made. It is too well known to merit more than passing mention here.

Hilgenreiner[2] found eight *postoperative stomach fistulæ* described in the literature, although this number impresses the author as being ridiculously low, in view of the fact that he alone can recall three of these accidents. He thinks the prognosis of a small stomach fistula to be very good, and considers spontaneous recovery by the patient favored by lying on the back, by cauterization, and by compression. He also thinks that the best operative treatment is gastrorraphy, possibly in connection with a plastic operation, and feels that every case should be operated on unless closure ensues within a short time. This has nothing to do, however, with cancer cases or patients affected by serious general disease. If gastrorraphy is not practical, gastroenterostomy or jejunostomy may be indicated.

The writer made a secondary laparotomy and successfully sutured a gastric fistula which had resulted from the presence of a drain tube in too close proximity to a gastroenterostomy suture line. In two other instances which are known to me, the patient's condition forbade any form of secondary operation. In one case, the pressure of a gauze pack, which was left in the abdomen for a period of several days, resulted in pressure decubitis and the formation of a very large gastric fistula which rapidly led to exhaustion and death. In another patient, a highly anemic young woman suffering from pyloric ulcer, a part of the gastroenterostomy suture line gave way eight days after the operation, and though the patient lived more than a month, still there never seemed to be a time when a secondary operation presented any possibility of being successful in stopping the leak.

Intestine.—The lesions which come under this heading, may be classified as *accidental* and *intentional.* The latter are made for the purpose of feeding the patient, rather frequently, in which case, the upper portion of the jejunum is chosen and a tube sewed into it, after one of several well-recognized methods. I have done this often, although it must be admitted that in malignant diseases of the digestive tube higher up, the results have been far from stimulating.

Fistulæ have been rarely employed for *therapeutic* purposes, especially in diseases of the large bowel, antiseptic and other fluids having been more frequently introduced through a patent appendix anchored in the abdominal wounds, than through a small fistula established somewhere in this vicinity.

Perhaps the most frequent of the fistulæ which may be classed as intestinal, are those made to drain obstructed intestinal coils, under certain circumstances: viz., when the patient's vitality is low and when at the same time it can be shown that there is no nutritional change in the intestinal wall. This procedure may attain life saving value. I happen to have in the hospital at this time, two patients who furnish examples in point, and show how radically different such fistulæ may functionate under various circumstances. A young woman became obstructed from pelvic peritonitis, and as a last resort, had a small fistula made ùnder local anesthesia. She immediately improved under drainage, and after a few weeks, began to have normal bowel movements, whereupon her fistula promptly closed spontaneously. The second patient referred to, an elderly gentleman, suffering from carcinoma of the rectum, was sent into the hospital, completely obstructed. A wholly similar fistula was made, and has continued to functionate, since there has been no let-up in the obstruction; secondary exploration of the abdomen has shown generalized peritoneal carcinosis, naturally an inoperable condition.

In rare instances, a life has been saved by the spontaneous appearance of a fecal fistula in appendicitis attended with dynamic obstruction. Not only has one often appeared several days after an appendectomy, but in an instance which recently came under my notice, one followed an incision made in the treatment of a phlegmon of the abdominal wall. It was noticed that with the escaping of gas and fluid feces, there was immediate relief of the symptoms—this was in a condition which seemed to threaten life.

Among the most common causes of *postoperative intestinal fistulæ* are the ligation of nutrient vessels, imperfect intestinal suture and strangulation by sutures, appendectomy with improper stump treatment, the leaving behind of a gangrenous perforated appendix and pressure necrosis of packs, tubes or other foreign bodies. The colon has been frequently wounded in the course of a nephrectomy or salpingectomy, while intestinal suture in the course of a peritoneal tuberculosis is exceedingly likely to be followed by fecal fistula. Many a strangulated hernia operation has terminated with the establishment of a fecal fistula, and no doubt, lives been saved thereby. One of the most common injuries of the duodenum results from the removal of an adherent gall bladder. There are other isolated causes of fecal fistulæ, but one of the foregoing accidents is very likely to be at fault.

The *location* of a fecal fistula may be determined with a fair degree of accuracy in many ways. The character of the discharge will aid one in determining the matter. If it is thick, it comes from low down in the tube, as is also true if it has a pronounced odor. Very little gas is formed high up, hence this is a matter of import. The presence of bile in large quantities indicates a lesion in the upper small bowel, as may be also said of the presence of undigested muscle fibers. Methylene blue given by mouth will appear unchanged in a fecal fistula. If an enema appears promptly in a fecal fistula, the surgeon can be fairly sure that the colon is affected, since under normal circumstances, no water passes backward through the ileocecal valve. Some authors have thought that the temperature at which ice cream or other cold foods appeared, was of value in settling this problem. Many observers have attempted to measure the exact distance of the fistula from the teeth, by feeding the patient an insoluble and undigestible substance attached to a string, and awaiting the appearance of this body in the fistula.

The **prognosis** of a fecal fistula is modified in many ways. If it is very high up, the patient may rapidly succumb to exhaustion, unless operative measures are attended with success. It is almost impossible to say whether or not a fistula will close spontaneously. This depends upon many factors, of which the most important by far, is obstruction lower down. A spur in the intestine at the site of a fistula is very likely to prevent the passage of intestinal contents in the normal direction, beyond its site, and is, therefore, of very bad prognostic significance. This is, however, most easily overcome by inserting one blade of a forceps into the bowel on either side of the septum and crushing through it. A completely divided gut furnishes the most intractable kind of fistula, not only as to likelihood of closure, but because emptying is interfered with as progressive narrowing of the lumen takes place and obstruction complicates the existing conditions. In addition to this, there is a great tendency for the distal portion to retract away from the wound in the abdominal wall, and, as time goes on, for this entire segment to become atrophic; in fact, this may progress to such an extent, in the course of years, that the bowel comes to resemble a fibrous cord, and because of the complete disappearance of the mucous membrane, can after the lapse of sufficient time, never be restored to function, even though the continuity of the tract be reestablished.

Several of the secondary pathologic changes which complete the formation of a fecal fistula were called to mind by a case which I was recently successful in operating upon, at what was for the patient, the eighth sitting. The bowel had been injured during some pelvic manipulation, and then six attempts made to close the opening without success, so that when she came into my hands, the following perplexing, though interesting, conditions presented themselves.

The ileum was completely divided and the upper end almost closed as a result of cicatricial contraction. A portion seemed to be missing, due to the fact that the lower segment had retracted to a considerable degree. This latter appeared to be of small caliber, but, nevertheless, end-to-end union was performed, resulting in a complete success.

Complications.—Prolapse of the mucosa through a large opening may attain gigantic proportions. The surface is likely to bleed if touched, may be exceedingly tender, and incarceration with spontaneous amputation of it is not unknown. Such a prolapse usually dilates the opening through which it comes, until a considerable herniation of other viscera may be present at the same time.

The patient's nerves suffer early in the development of a fecal fistula. As a matter of course, and in many instances rightly, the unhappy individual considers himself ostracized. However, I knew of one man who conducted a high grade restaurant for a long time, in which he served patrons who were unaware of his distressing co dition.

The most annoying skin affections complicate fecal fistulæ. The higher the fistula, the more true this is, largely on account of the presence of pancreatic juices which simply digest everything with which they come in contact. I have been disappointed in the use of the oily substances so frequently suggested for the treatment of this condition, but have been uniformly satisfied with the use of a full body bath wherever obtainable. One patient spent about one-half of her time in the water and was not annoyed in the least as long as she remained in the tub. Of course, provision must be made for keeping the water at body temperature and protecting the patient from pressure decubitis, by the use of rubber rings or other materials having the same purpose in view. The feeding of large amounts of sodium bicarbonate and other alkaline substances was found beneficial in this same case, no doubt by stimulating the secretion of an excess of hydrochloric acid, which, to a corresponding extent, neutralized the alkalinity of the pancreatic juice, and thus limited its digestive power. I have nowhere seen this advocated, but warmly suggest a future trial of it.

Tetanus has not infrequently complicated operations on fecal fistulæ. This is natural enough when one remembers that the intestinal tract of man, as well as of the lower animals, is the natural habitat for the tetanus germ, hence the disease may occur wherever there is fecal soiling. It is therefore recommended by many authorities, that a prophylactic dose of anti-tetanic serum precede any operative maneuver intended to cure fecal fistula.

The *prognosis* is almost uniformly good in that very common type of fecal fistula which follows the removal of the appendix under circumstances which prohibit our doing more than merely ligating the stump and dropping the gut back with a drain tied to it. If there is localized peritonitis, the bowel wall is too thick and friable to admit of suturing, and a ligature rapidly cuts through. However, the fistula is of only a few days duration, unless nutritional changes have forced us to ligate well up onto the head of the cecum, so that a very large opening results.

The **treatment** of fecal fistulæ may be divided into (1) prophylactic, (2) conservative, and (3) operative. They may no doubt be prevented in many instances by care in separating adhesions, conserving the blood supply of the bowel, careful suturing, by avoidance of contact with packs or drains at suture lines, and by the very earliest possible removal of them wherever employed in the abdomen.

Fistulæ will frequently be prevented by the routine removal of the appendix in pus cases where there is not an absolute lethal contraindication.

Conservative treatment consists largely in the avoidance of cathartics, and the use of small enemas which tend to create peristalsis below the fistula, as well as in the giving of food which leaves a minimum of residue. To this may be added plugging or pressure approximation of the outlet, as well as the various forms of stimulation mentioned in the beginning of this chapter.

The operative treatment may consist of simple abdominal wall plastic, some form of enterorrhaphy or intestinal exclusion. I, personally, have rarely seen a simple plastic successful in this treatment, hence mention it only to condemn it. There may be isolated instances, and no doubt are, in which one of the forms of exclusion is indicated in cases where a direct repair would be too hazardous; however, its usefulness is decidedly limited. The needs of the ordinary case are no doubt best met by enterorrhaphy. It is always best after a thorough purgation and cleansing of the fistula to loosen the bowel completely from the abdominal wall, and to suture it in such a manner as to leave the widest possible lumen. If the intestine has not been damaged too much, the transverse reunion of a longitudinal defect may answer all the requirements of the case.

An admirable procedure in many instances, is a partial, wedge-like resection which goes back into perfectly healthy bowel, leaving the vicinity of the mysentery intact, and uniting the cut edges in a transverse direction. This is the method which I have chosen where possible, and when the intestine has not been found completely severed; it has given uniformly good results. In a small number of cases, end-to-end or less frequently, lateral anastomosis will be indicated after partially closed and widely divided ends have been isolated and brought into approximation.

Multiple fistulæ are sometimes extremely difficult to locate, so far as their origin is concerned, hence exclusion of a bowel segment may, for this reason, or on account of a patient's condition, seem advisable. It may be stated, in passing, that partial exclusion produced by lateral anastomosis is rarely a satisfactory operation, because the intestinal current tends to follow the normal direction, past the anastomotic opening. A complete exclusion, on the other hand, will, as a matter of course, absolutely divert the fecal stream, but it must be undertaken with the full knowledge that the fistula must persist for the discharge of intestinal secretions, else the completely excluded segment will distend to a condition necessitating its removal, or at least, permanent drainage of it.

No fistula can be closed so long as *obstruction* lower down persists, hence this underlying condition must be treated before there is any thought of curing the fistula. The reader is referred for details to the chapter covering this subject.

Other Varieties of Postoperative Fistulæ.—Parotid fistulæ, while not very common, are sometimes extremely stubborn and must be considered, as they now and then complicate operations done in this region. An ingenious proposal for treating them is that which is given by Le Riche, (Le Riche, R.: Treatment of Permanent Fistulæ of the Parotid by Destroying the Innervation of the Salivary Gland, *Zentralbe. f. Chir.*, 1914, xli, 754) and which is as follows: "In order to avoid total extirpation of the gland in stubborn fistulæ of the parotid, the fistula can be obliterated by destroying the secretory nerve of the gland. This is continued in the auriculo-temporal nerve, which divides into several branches back of the condyloid process. The nerve is laid bare at 'the point of election,' dissected with its branches up to the gland, and slowly twisted out by Thiersch's method. This method has been used in three cases with complete success."

Fistulæ of the thoracic duct occur only after accidental wounding of this structure during the removal of the deep cervical lymphatic nodes low down in the left side. Such have been reported by Lund[3] and also by Harvey Cushing.[4] The prevailing symptoms in all have been a more or less copious discharge of lymph from the wound, with rapid emaciation of the patient. The prognosis is not so bad as might be thought at first, on account of the fact that these ducts are multiple, and as a rule, are not all severed. The treatment has been by repair and ligature where the accident has been discovered during the original operation, and by tampon, with subsequent cicatrization. In addition to drainage and protection of the skin, one must naturally do all that is possible to keep up the patient's strength until the branches of the duct which have not been injured compensate for those that have been lost. To this end, the rectal administration of 5 per cent glucose is heartily recommended.

Bronchial fistulæ are not uncommon after operation for chronic inflammatory lesions within the chest cavity. Dr. Walton Martin[5] reported five cases of this kind. He states that simple straight fistulæ of this variety have closed spontaneously. If, however, a portion of the fistula constitutes a bulbous enlargement in the lung tissue, there is very little chance of this happy outcome, because drainage is faulty.

The best treatment seems to be improved drainage for a prolonged period; in the event of this failing, some form of plastic operation is indicated.

Umbilical fistula is fairly common when the embryonic possibilities of the digestive or urinary tracts are considered, but as a postoperative condition, it must be rare, only one instance of this kind having presented itself for our observation. The patient was a small boy, who discharged only a small quantity of pus from the navel. The only etiologic factor of importance which could be elicited was an operation for inguinal hernia done several years previous. As he had pain in the affected groin when the fistula was not discharging, I made an inguinal incision and found a heavy silk suture lying in a walled-off cavity just outside the peritoneum, the same being connected with the umbilicus by a tract which easily admitted a probe throughout its entire length. The removal of the silk promptly cured the patient.

Gall Bladder Fistulæ.—A gall bladder fistula of temporary nature is so commonly employed in the treatment of inflamed conditions of this viscus, as to merit more than passing mention. It may persist if the cystic or common ducts are obstructed, when it becomes an annoying, though not usually, a dangerous matter. I have very frequently explored a gall bladder under circumstances which made cholecystectomy seem dangerous, and found no bile in the bladder, nor did any appear until some weeks later. This is a matter of utmost import, since bile drainage indicates patency of the cystic duct, and if there is no obstruction to the common duct, such a fistula closes spontaneously. Where bile does not appear after permanent closure of the cystic duct has taken place and the need for gall bladder secretion to escape entails a mucous fistula of permanent or intermittent character, there seems to be no adequate treatment for this condition except the secondary removal of such a diseased gall bladder.

Obstruction of the common duct as the cause of a gall bladder fistula entails quite another problem; viz., the relief of the obstruction *per se*—by the removal of the stone. In many such instances the removal of the gall bladder will be undertaken at the same time, provided the ducts are known to be clear, since the greatly diseased bladder which usually accompanies this condition, is of no value to the patient. In one such instance, however, I saw a patient, after draining many weeks, pass her common duct stone and make a spontaneous and permanent recovery.

Where a gall bladder fistula appears as a result of inflammatory thickening in the head of the pancreas, spontaneous cure is the rule, or pancreatitis is treated and the fistula taken care of at the same time by the establishment of artificial anastomosis between the gall bladder and some portion of the digestive tract. In cancer of the pancreas, the patient's condition would rarely warrant an operative procedure calculated to cure a fistula, which will, at best, annoy the patient for a limited period only.

Fistulæ of the Urinary Tract.—Renal fistulæ are not uncommon after the drainage of a pus collection within the kidney, especially where there is urinary obstruction due to stone I have done a nephrectomy in a number of such instances, because, as a rule, one finds that prolonged suppuration has so damaged kidney substances as to make any conservative procedure of doubtful value. I have never seen a permanent fistula of the ureter follow the removal of a stone from this tube, although there has never been any attempt made to suture its walls. On one occasion, we were forced to do a secondary nephrectomy for continued profuse urinary drainage, due to the complete division of a ureter, during an attempt to relieve a stricture low down. Perhaps the most common cause of such fistulæ is that brought out by Furniss,[6] and is here given: The author believes that the greatest number of ligated and severed ureters occur in hysterectomies for uterine fibroids. Since extensive operation for cancer has come into general practice, there has been an increase in the number of ureterovaginal fistulæ. In this operation the injury is most often due to temporary clamping of the ureter, which is later followed by necrosis and sloughing. Sampson has stated that prolonged tying of the ureter is less dangerous than temporary clamping, and this statement has been proved by clinical observations.

He writes: "Most fistulæ result from necrosis of the ureter, due to rough handling, too extensive dissection or clamping. In all these fistulæ there is a marked inflammatory condition around the end of the ureter, and this is to be remembered in operating. In the beginning it is so great that the repair of the abdominal fistulæ by another anastomosis has little chance of success. In the incomplete variety, especially when only a small spot on the ureteral wall has been injured, there is not so great a likelihood of the ureter becoming obstructed, and for this reason, the function of the kidney is not impaired. After the lapse of four months, with no improvement, there is little hope of the fistula closing."

Fistulæ of the Urinary Bladder are most commonly of the vesicovaginal type, since this viscus is so often exposed to injury in gynecologic and obstetric practice. The diagnosis and general circumstances surrounding such cases are too well known to make extended mention needed here. Ward[7] has advanced a plan for treating these cases, which should be read in the original to be appreciated.

Parham[8] reports two unsuccessful attempts to close such a fistula, followed by a third successful issue after the Ward technic was employed. Multiple operations have been the rule rather than the exception, where an attempt has been made to close a vesicovaginal fistula. The location of such a lesion and the amount of scar tissue around it may prove to be determining factors in the treatment. An excision of the tract with multiple layer suture on as broad surface as can be secured, has been attended with ultimate success in all of our cases, although I have, perhaps, been fortunate in encountering fistulæ of only moderate size, which could be fairly easily mobilized. I have invariably employed a permanent catheter, and have felt that I was aided by keeping the patient from turning on the back at any time during the week following the operation, thus minimizing the tendency of gravity to defeat my aim. An interesting vesicouterovaginal fistula was treated by MacLean[9] and reported. His method was to swing the cervix into the bladder and anchor it there.

Fistulæ connecting the bladder with some portion of the colon have occurred frequently only after operations for inflammatory diseases of the pelvic viscera in women. Duncan[10] reports one such in which the condition was successfully treated by a relaparotomy, with separate closure of bladder and rectum.

Cunningham[11] describes the treatment of *enterovesical* fistulæ from the viewpoint of the urologist. He divides the operative treatment into (1) abdominal section, with separate suture of both viscera, (2) perineal operation for a very low lesion, with permanent catheter and packing of rectal wound; (3) colotomy for the purpose of draining the feces; (4) suprapubic cystotomy where nothing else can be done to rid the sufferer of the presence of the feces in the bladder.

No doubt the most common form of enterovesical fistula which affects the male, is that between bladder and rectum, and which complicates perineal prostatectomy. Now that most surgeons employ the suprapubic method so extensively, this complication is less seen than formerly. My own experience in this line is very small, but I must admit with chagrin, that I can not claim a single success in its operative treatment, hence urge prophylaxis above every other consideration. Young and Stone[12] have treated urethrarectal fistulæ in several instances, by a plan which might be modified, it seems to me, and adapted to the treatment of vesicorectal conditions of similar nature. They divide their operation into four essential steps. These are:

(1) Suprapubic drainage.
(2) Resection of a cuff of rectal mucosa containing the fistula.
(3) Suture of the urethral orifice.
(4) Building up of a heavy perineal body with repair of the sphincter ani.

Urethral fistulæ occur according to Lothrope[13] after extravasation, perineal prostatectomy and operations for stricture.

Operative treatment should be deferred, according to this author, until the acute inflammatory reaction has passed, then the fistula should be isolated and dissected loose with a sound in the urethra, after which it is ligated near its inner end and the divided tissues united in layers over the sound.

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CHAPTER XXIV

SINUSES

By O. F. McKittrick, St. Louis, Mo.

Sinuses are so frequently seen after operations that the proper care and attention of this complication demands more than passing mention. In fact timely aid in such conditions rarely fails to bring reward in the form of relief of the causative factors with the ultimate cure of the patient.

A sinus, as generally understood, is a tract of varying length and size, passing from some point of tissue necrosis or actual abscess to the free mucous or skin surface. In postoperative cases the sinus most usually results from some portion of the wound which has not healed; or where pus has burrowed in parts of the subcutaneous tissues with secondary openings at the body surface. Sinus formation following operations for osteomyelitis is a common occurrence as is also often the case after a pus appendix, though a tract may form after other abdominal, pelvic or thoracic operations. A foreign body left in the abdominal cavity (such as a sponge, etc.) not infrequently is the source of a persistent drainage tract. The sinus will continue so long as the offending material is present, as is the case in the bony sequestrum in the osteomyelitis, and the sloughed off appendix in the pus appendix cases. In other instances the constant irritation of bile, saliva, urine, etc., may be the cause of a persistent sinus.

Sinuses may present themselves in surgical wounds as a result of nonabsorbable ligature material, absorbable ligatures which have become infected or other irritative factors as a sequela to the operative procedure alone. Foreign bodies, such as dirt, wood, pieces of steel or a bullet may be the seat of annoying discharging tracts in wounds caused by injuries. In any wound where there is improper rest due to muscular movements, or in tissues of low vitality sinuses may persist as a result of these reasons alone. In patients with poor general health sinus formation is the rule rather than the exception. Thus in the tuberculous drainage is not even attempted because of this fact.

The lesson never to drain a tuberculous lesion was learned long ago in the attempts to handle tuberculous appendicitis in the usual way, which so often resulted in nonhealing of the wound and the developing of a persistent sinus.

The treatment first consists in determining the cause of the condition and measures undertaken at once to remove it. No sinus will ever permanently close so long as the offending causative factor is left undisturbed. For this reason one must endeavor to keep the external opening free from the crusts which will form over it, and if necessary insert a rubber drain throughout the extent of the tract and from time to time cut away with a sharp pointed scissors the granulations as they become obstructive. The same thing may be accomplished with the silver nitrate stick or a sharp curette. This instrument is indeed, very useful in long tortuous tracts which tend to close by granulation tissue a considerable distance from the outlet. While the tract itself is kept open, nature has a chance to discharge any offending material from the bottom of the sinus and to heal the cavity in the usual way. Pus and all other discharges arising from granulating walls, having a free outlet, allows the walls to quickly collapse and soon to be completely obliterated by means of granulation followed by scar tissue. Such a process in the very large cavities may require months to complete its work. During this time one must persist in keeping a free opening for the secretions.

If there is any reason to believe that the sinus persists because of some foreign body which has not been discharged despite every effort to give the tract free drainage, one should probe the cavity thoroughly in the hope of dislodging the foreign member, or if it be a piece of gauze or suture, one should entangle it in the instrument and thus remove it. A sloughed off appendix, foreign body left in the abdominal cavity or wound will probably require a secondary operation. A sequestrum of bone may also require such radical treatment, though time, without further measures other than those mentioned above, will usually correct difficulties arising from this source.

A sinus may persist long after the causative factor has been removed. Such is indeed the case usually in those instances where it is necessary to keep a free drainage tract over unusual periods. The walls of the sinus become infiltrated and hardened due to the chronic inflammatory process. Sinuses arising from bone or cartilage naturally persist because of the nature of the tissue. This alone prevents collapse of the sinus cavity and therefore forces the defect to be closed wholly by granulation.

Constant irritating discharges such as bile, etc., will often cause the sinus to persist. In such instances the granulations often develop slowly and measures must be employed to stimulate not only the granulation tissue itself by scraping the walls of the sinus with a curette until healthy tissue is reached, but also to actually dissect out the entire tract and close it with buried catgut sutures. When the bottom of a sinus is so situated that an opening can be made to the outside and thereby give through and through drainage, this should be done. Such a maneuver permits of thorough cleansing with some antiseptic solution and frequent irrigation will discourage bacterial growth and hasten the growth of the reparative tissue. Irrigations of sinuses with 4 per cent boric acid solution or Dakin's fluid three or four times a day is encouraged in those instances where the sinus does not extend into the peritoneal cavity.

For sinuses about the mouth, or those resulting from surgical wounds of the neck I usually employ 80 per cent alcohol or ½ per cent alcoholic solution of iodine once a day. The same solution may be utilized in any sinus where the solution readily returns. One should never employ solutions which will injure the new tissue along the tract during the attempt to cleanse it of discharge and clear it of bacteria. For this reason the alcohol is permissible but once a day, whereas solutions as mentioned previously may be used much more frequently. When the cause of the condition can be with certainty eliminated, so far as foreign bodies are concerned, other remedies in addition to the ordinary cleansing of the tract can be employed with success. In the most persistent sinuses these become necessary if operative interference as suggested above is not to be considered.

Among the many suggested remedies, iodized phenol as employed by Cotes[1] may be mentioned though remedies which have proved of value through years of usage, such as Beck's[2] paste, probably should be used. His method was first employed as a diagnostic measure. The paste was injected into sinuses and x-ray pictures taken later to show the tract in detail. It was soon found, however, that following the injection, particularly in tuberculous sinuses, not infrequently the tract would heal without further measures being necessary. It was discovered that the bismuth, being antiseptic, besides forming a network for the granulations to grow in, offered the best medium for the healing of these defects. It also acted as a foreign body, thereby stimulating leucocytosis and by its mechanical action kept the walls of the sinus open. This permitted closure from the bottom upwards.

As generally employed, the sinus is injected with a "liquid bismuth vaseline paste," by means of an ordinary glass syringe (usually 20 c.c.) every other day until the tract ceases to discharge. The paste consists of bismuth subnitrate, 1 ounce, vaseline, 2 ounces. The two are mixed over a water-bath and the mixture injected while it is at a temperature of 110° to 120° F. It should be put into the sinus under slight pressure so as to fill every part of the tract. After a few days, when all discharge has stopped, Beck[2] uses a mixture which forms a much harder paste at body temperature. This forms a more substantial framework, inside the sinus tract, for the granulation tissue to fill. To the 3 ounce mixture of bismuth and vaseline, Beck adds 75 grains each of white wax and soft paraffin. Beck[2] states that the tract closes after the employment of the latter paste, and in most instances remains closed, during which time the paste becomes absorbed and replaced by granulation tissue.

Soon after the use of Beck paste in the ordinary sinuses which occur in the body, other than those connected with the thorax, Ochsner[3] demonstrated its value in this capacity, stating that sinuses resulting from operations in empyema cases soon become sterile and rapidly close after injecting the mixture in the usual way.

Like all good remedies applicable in medicine, the paste was found not to be useful in every case of chronic sinus, tuberculous or otherwise.

Among the other pastes are Mitchell's,[4] which consists of a mixture of equal parts of petrolatum and chalk. He states that this paste will accomplish the same result as the bismuth paste and that it is even more useful, since it contains calcium which is an active chemical and that poisoning is not possible with chalk paste.

Blanchard[5] simply employs white wax one part to eight parts of vaseline. In cases where an antiseptic paste is desirable as in virulent infections, he adds iodine crystals which have been reduced to a powder by rubbing in a mortar to which 20 per cent potassium iodine solution has been added. Two or three grains of the powder are mixed with the paste and injected into the sinus, using the same technic as with bismuth paste. If x-rays are to be taken of the sinus, Blanchard uses a mixture of ferri-subcarbonate one part to two parts of white vaseline. The mixture is boiled and at the same time it is thoroughly mixed. The author claims to have cured ultimately 65 per cent of old tuberculous sinuses which is as many as those cured by the bismuth; the attendant bad effects of the latter drug such as clogging of dependent portions of the abscesses or sinus walls with the heavy metal or poisoning are entirely eliminated.

Sweek[6] does not use injections of any kind, since he feels that any method as outlined above in killing off the bacteria we destroy the newly formed granulation tissue. He, therefore, uses a germicidal gas which he causes to pass into the sinus from ten to twenty minutes each day or every other day, depending on the severity of the case. Air is passed through crude spirits of resin and then through the poles of an electric arc, from here into a tin gallon jar from which it passes into the sinus. The slight aging the gas undergoes in passing into the jar causes it to have a somewhat irritating effect on the nose and bronchi, but does not irritate the wound to a noticeable degree.

Sweek[6] claims that the minute or minute and one-half which the gas requires in passing through the jar so ages it that its bactericidal power is materially enhanced. He claims that the wound healing is not retarded in any degree and that we can expect greater results from this gas than any known germicide. His method should be tried before one despairs in the treatment of this annoying complication.

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CHAPTER XXV

DRUG ADDICTION IN SURGICAL PATIENTS

By O. F. McKittrick, St. Louis, Mo.

It is common experience that the average surgeon pays very little attention to drug addiction, if discovered at all, in his patients, and inclines to regard it as a matter which does not concern him. This stand can be defended if the surgeon accepts the responsibility for his work during the operation only, but anything which has to do with the recovery and subsequent well being of his patient should command just the same interest and respect.

Bishop[1] holds that the medical profession has regarded the continued use of a narcotic drug as the element of paramount importance in drug addiction and that too little attention has been given to the *action* of the drug, which produces such a condition, and that the "physical mechanism" of drug addiction has greater influence in the healing and repair than had been formerly supposed.

He points out that very many surgical cases have terminated badly or at least unsatisfactorily, solely because the surgeon failed to grasp the importance of the drug addiction, and his inability to successfully deal with such a condition existing intercurrently in surgical patients. The medical treatment of narcotic drug addiction has concerned itself chiefly in withdrawing the drug. Until this has been accomplished, operators will frequently not attempt any work on a patient, since such have been considered poor operative risks, besides being difficult to handle. But such a stand is not justified by clinical facts. "The habitué is not a poor surgical risk merely because he is addicted to his drug." The slowness of recovery and lack of repair which have been noted in these cases is not due to the drug of which he is the slave, but rather to the fact that his surgeon is unable to cope with his acquired condition, or in many instances, it is not even recognized. There can be no doubt that such patients have been operated upon and have passed through a satisfactory recovery and convalescence without their addiction even being suspected.

Provision is usually made by the wiser "addict" for such emergencies and he himself, controls his disease. For it is a disease[2] and "the amount of the drug which the patient must use is of minor importance compared with his functional, nutritional and metabolic efficiency."

According to Bishop, the satisfactory recovery of a narcotic addict from a surgical condition depends largely upon his "functional balance" and upon his "organic adequacy." Such are largely under the control of, and vary with, the extent to which the patient is kept in "narcotic drug balance." It follows, then, that the reduction of the dose of the accustomed drug below the amount which the addict physically needs is not only without justification, but also is harmful to the patient and the result is seriously prejudiced.

Why such a condition should present itself at all as a menace to surgical procedure has never been explained. Drug habits have been common since time immemorial. The use of opium has been practiced by the Orientals throughout the ages. These people used it in the belief that the drug was helpful to them, and even today, they are still using it in much the same way as the Western peoples use coffee, tea, or tobacco.

Its use is mentioned in the Egyptian hieroglyphics, and centuries later in the writings of Homer. Since the beginning of the nineteenth century, however, chemical study and experimentation have revealed its composition, and since that time, the alkaloids of opium have played a more or less prominent part. The danger of morphinism was first recognized in 1866, in France,[3] the hypodermic use of this drug having at that time come into prominence there.

In this country, opium as such, is not commonly used. Morphine is the alkaloid of choice. It is said that 85 per cent of habitués take it subcutaneously. Occasionally, codeine or heroin is used instead. Opium is usually smoked, though it is taken by mouth in the form of opium pills or laudanum. Cocaine may also be used by such addicts, the drug being taken by insufflation or by mouth.

Morphine addicts, like chronic alcoholics, are divided into two great classes; those who are habitual users and those who use the drug periodically; the morphine or opium being entirely abandoned in the interval.[4]

It is common to find among women[4] periodic addicts to this drug, traceable in most cases, to some pelvic trouble, to recurring attacks of headache or to neuralgia. The habitual user is much more easily handled than is the periodic addict. However, the former class is more difficult to treat than the class of patients who have taken large amounts of morphine but for only a short period of time.

The symptoms of morphinism can not be fully gone into here, but as seen in the chronic form, there is a change of personality indicated by alternation of mood; viz., periods of depression, suddenly followed by intervals of euphoria. To this is usually added a capricious appetite, constipation or possibly diarrhea. The nutrition suffers, the subcutaneous tissue gradually shrinks and the skin becomes loose. The face is usually ashen or sometimes deep red in color. The pupils are generally contracted and react poorly to light. There may occur double vision. Hoarseness, thirst, and tremor are common symptoms. If the patient has been deprived of his drug for any length of time, he becomes restless, anxious, and salivation with coryza probably appear; he may become nauseated, and vomit. Disturbances of vision, neuralgic pains and a choreic form of jactitation make their appearance. The pupils become dilated, a stage of wild excitement develops, and, no matter how secretive the man may have been before, he now begs for his drug.

The action of narcotic drugs upon the organism reveals itself through inhibition of body function. Glandular activity is arrested and the metabolic processes are markedly diminished. The smooth musculature throughout the body is paralyzed by their action, and since this class constitutes the musculature of the intestinal tract, peristalsis is inhibited. This results in diminution of the intestinal glandular secretion and therefore elimination suffers. This inhibition of function not alone causes a storage of poisonous drug within the body, but prevents the complete elimination of toxic products which are the result of tissue destruction, and interferes with metabolism as well.

Such a condition, Bishop says, brings about autointoxication. He also points out that "the predominating manifestations of this disease depend upon the extent of the inhibition of function and upon the degree of autointoxication." The circulatory, digestive and nervous systems are affected by such a condition. The mental deterioration and other symptoms so often ascribed to the drug alone are as a matter of fact, the result of these factors.

As to the treatment, one must study the individual case. The drug should be supplied in such amounts as are necessary to carry on the body functions. The inhibitory effect should be cut to the minimum by giving it at sufficiently wide intervals. This inhibition of function can be lessened by relieving the patient, so far as possible, of fear, worry, anxiety or criticism, and by trying to gain his confidence and respect. The physician must not consider the condition anything else than a disease, since the patient takes the drug to meet the definite indications. The mere fact that a patient indulges does not constitute his disease or the withdrawal of this drug constitute his cure. The dose must not be reduced until the physical need for this substance has been diminished. Unskilled withdrawal is responsible for many relapses.[5] "An improved tone of the body, an increased ability to assimilate food taken, and a proper elimination are of far more importance than the mere fact that a smaller amount of the drug is being taken." When the patient has progressed far enough in the convalescence to permit of active eliminative processes being carried out, the autotoxemia can be disposed of. As suggested by Pettey,[6] one must first overcome the inhibitive effects of the drug in order to get the best eliminative results in his efforts to eradicate the products of autointoxication. Pettey uses strychnine in sufficient doses to stimulate the semiparalyzed intestines to efficient peristalsis. Efficient peristalsis being maintained and elimination being active, Pettey found that only one-fourth of the usual quantity of drug was necessary to meet all the patient's demands, and after a few days, the opiate can be withdrawn entirely. Nausea, colic, and other gastrointestinal symptoms which are so often noted following other forms of treatment fail to appear, and, within a few more days, the patient can be discharged without collapse ever having threatened.

Another method of treatment may be employed, even in weak or debilitated persons, who have been prepared along the lines suggested above. Since this method takes but a short time, it is desirable, if possible, to have the patient well advanced in the convalescence before any attempt is made to relieve the drug addiction permanently. As suggested by Town[7] and later supported by Lambert,[8] it is as follows, according to Hare: "The patient, being under absolute control as to his ability to obtain morphine, is given five compound cathartic pills and in addition, five grains of blue mass. Six hours later, if these have not acted, a saline purge is given. After the patient has three or four copious movements, he receives, by mouth or hypodermic injection, according to his custom of taking the drug, two-thirds to three-fourths of his total daily intake in three divided doses at half-hour intervals. Six drops of a mixture of tincture of belladonna, 2 parts; fluid extract of xanthoxylin, 1 part; and fluid extract of hyoscyamus, 1 part, are given in a capsule at the same time as the morphine, cocaine or alcohol and repeated every hour for six hours. At the end of six hours, the dose of this mixture is increased by two drops and it is continued every subsequent hour, day and night, being increased by 2 drops every 6 hours until 16 drops are given at a dose. If the patient shows very marked symptoms of the physiologic action of the belladonna mixture, the amount may be decreased, but on the other hand, if he is resistant to the drug, it must be increased up to 20 drops every hour. Ten hours after the first dose of morphine has been received, the patient is again given five compound cathartic pills and five grains of blue mass; if the bowels do not act in 6 or 8 hours, a vigorous saline purge is administered. The morphine is used after this purgation in half the original dose, and ten hours later the same number of compound cathartic pills and the same amount of blue mass is given. After thirty-six hours have elapsed from the beginning of the treatment, the third dose of morphine, which is one-fourth of the original amount is given, and it is claimed that this is usually the last which is needed. Forty-six hours after the beginning of the treatment, the compound cathartic pills and blue mass are given again, followed by a saline, and possibly as late as the fifty-sixth hour of treatment, a fourth small dose of morphine may be used with two ounces of castor oil.'' If the treatment nauseates the patient, calomel in small doses combined with a little sodium bicarbonate may be used instead of the pills. The pain which such a treatment will cause, may be eased with codeine or dionine. Strychnine and, if necessary, digitalis should be used as supportive measures. Osler says the most valuable tonics, following the treatment, are those which contain some form of phosphorus and arsenic.

Other forms of treatment have been devised by Erlenmeyer,[9] Seeleth, and others.[10] Regardless of the method, however, the future of such a patient must be guarded. Placed in good environments, given proper diet and plenty of exercise, he will gain soon in weight and in spirits while his health will become excellent. It is claimed that 80 per cent may remain well under such conditions.

Since the introduction of the Harrison Law, it is more than ever desirable to help patients free themselves from this addiction. The drug is not easily obtained and recurrences are, therefore, not so frequent.

After all, abstinence from the use of narcotic drugs depends upon the individual. If there is no inborn force of character, there is but little hope of a cure. ''The human zero, plus or minus drug addiction equals zero!''

The statements made concerning the treatment of opium and morphine apply equally well to *cocaine*. The Town method is particularly indicated here. Strychnine as used in opium cases is very desirous here, but some form of digitalis should be given along with this drug. Following the treatment, the patients require a much longer period in which to build up physically, than do the morphinists, and hence, really require longer attention. The treatment should be carried out before any operative interference, but if this is not possible, the prognosis is very little affected because of the fact that the patient is a drug addict. As with morphine, no strenuous efforts should be made to cure the habit until late in a successful surgical convalescence.

The treatment of chloralism, trionalism, sulphonalism and other narcotic drug habits is carried out along the same general lines of elimination and withdrawal of the drug. In each and every case every hygienic measure is employed to put the system in normal tone. The permanence of any result depends upon the patient himself and upon his association.

Tobacco, coffee, and *tea* are so commonly abused that patients with such habits are operated upon as a matter of course. The ordinary use of either of these drugs does not necessarily increase the surgical risk, but the continued abuse of any one of them over a long period of time may cause serious untoward symptoms, when the additional strain of an operation is superimposed.

Tobacco is a poison,[11] the excessive use of which may produce palpitation, irregular action of the heart, paroxysms of asthma, angina pectoris, tremor, muscular weakness, loss of sleep, sometimes symptoms of tabes, amblyopia, gastric disturbances, chronic catarrh of the pharynx and larynx, neuralgias and headache.[12] The minimum amount of this weed should be used, if any is used at all, during the preoperative treatment; there must be careful etherization during the operation, and none of this luxury is allowed during the convalescence unless the desire to continue the habit is so great as to cause nervousness and wakefulness, in which event the least amount that will satisfy the patient's need, is permitted.

Coffee and tea owe their effects to the caffeine which is contained in each; one cupful of either beverage contains, according to Cushny, 1½ to 3 grains of this alkaloid. The action of caffeine on the body is chiefly stimulative.[13] The brain and the whole nervous system are affected. The heart and the musculature throughout the body are likewise influenced. Moderate doses cause a rise in the blood pressure. Respiration is increased in rate, and metabolism is considerably stimulated. Gastric juice is increased by ingestion of coffee, though tea has an opposite effect.[14] In addition to caffeine, tea also contains tannic acid and because of this, may produce indigestion and constipation. Sudden deprivation of either beverage may be followed by extreme nervousness and wakefulness in patients long addicted to their use in excess. Headache is a common symptom following the withdrawal of either drug. Such patients should be given much less than the accustomed amount of the beverage when preparing for an operation. The danger of the operative procedure is not enhanced or, at least, but slightly; though during the convalescence, the minimum amount of coffee should be permitted.

In highly nervous cases and especially in toxic goiter patients, no stimulating beverage is allowed at all.

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CHAPTER XXVI

ALCOHOLISM IN ITS RELATION TO SURGERY

By O. F. McKittrick, St. Louis, Mo.

Alcoholism is found in all walks of life, and occurs in all classes of society—a condition as needless as it is harmful, also one which presents serious difficulties in the way of the successful outcome of a surgical convalescence. Just why this detrimental condition must remain a factor even in the present day surgery, is a secret which the chronic alcoholic in many instances alone can divulge. The reasons for drinking are varied. The habit is begun early in life, usually before the age of 30,[1] but very commonly it is given up between 40 and 65.[2] Unfortunately, those who yield to its clutches and become its slaves are usually of the neurotic type. In such patients, an operation itself being very serious, alcohol does its greatest damage. The two most important classes of alcoholic cases which present themselves for surgical treatment are the constant daily drinkers, who must have their regular portion, and the periodic drunkards who between times probably do not touch a drop of liquor.[3] It is a matter of common knowledge that patients who do not drink get along a great deal better than do the alcoholics during surgical procedures. The temperate alone possess calmness of body and mind and the ability to respond promptly to stimulation which so often obviates shock. Such a resistance to the deleterious effects of an operation is not possessed by those whose vital powers hàve long been driven by the overstimulating effect of intoxicating liquor.

The observation of Cheever,[4] that such patients undergo a "laborious and excitable etherization" is a common experience among all operators. This is not surprising when one considers that once confirmed in the use of alcohol, an individual goes the downward road that leads to complete mental and physical decay.[5] The damaging evidences of the poison are presented in every organ of the body. The brain and meninges at times become edematous, the cells throughout the nervous system degenerate, the arteries become sclerotic and the veins dilate, all of which leads to a "labored and slow circulation." The tissues throughout the organism become hardened and thickened, which necessarily delays absorption, and the natural activities of various cellular functions. There is fatty degeneration of the parenchyma of the liver, pancreas, and kidneys, in addition to fibrous changes; the mucosa of the pharynx and stomach become thickened and hyperplastic. Such pathologic conditions give rise to symptoms such as tremor, gastric irritability, enfeeblement, physical and mental, which gradually grows worse as the years pass; also increased blood pressure and albuminuria.

Such a condition is certainly detrimental to the patient who is suddenly brought to face accidents or operative procedures. Even in selected operative cases, no amount of preparation can repair the structural damage already wrought, and the patient is subjected to added danger in consequence. The daily tippler who on rare occasions only gets drunk, is a much better risk than the man who periodically gets intoxicated.

The prognosis for the former is, however, much more grave if the operation be accompanied by severe hemorrhage or shock, since the resistance is, without doubt, more or less lowered from the continued use of alcohol. The periodic drunkard presents a somewhat different problem and more serious risk. Not in the habit of drinking daily and probably not thinking about the necessity of preparing himself with his stimulant, he fails to make his weakness known, is admitted to the hospital, no alcohol is given, and he is operated upon for some trivial condition it may be. But it apparently does not matter how insignificant or how serious the operation may be, it is the alcoholic condition of the patient which makes the surgical procedure hazardous. The trauma of the operation added to his already altered condition, breaks down what defenses he may have.

For a few days he may do well, but a prolonged abstinence from alcohol causes him to become restless, nervous, and exceptionally keen to happenings around him; small and insignificant acts of others are irritating to him. Sleep is very poor and he has hallucinations which seem to him dreams and disturb him, although he knows they are unreal. For several days[6] the patient may be concerned about himself; there may be a distressed feeling in the epigastrium or singing in his ears which at times may seem to be voices. He may complain of dizziness; tremor develops in his hands, and his tongue trembles. Finally, if nothing is done to avert the calamity, delirium tremens develops.

Delirium Tremens

It is common knowledge that delirium tremens is apt to develop in regular drinkers following operation or with the beginning of pneumonia. It is most common in emergency operations after injuries, in patients who are chronic drinkers. The patient, however, may never have been in the habit of becoming actually drunk.

Following the operation or injury, the patient has an almost sleepless night. The brief periods of sleep which may occur, are filled with horrible dreams. Morning finds him restless, nervous, tired, suspicious and apprehensive, the appetite is gone and he may or may not crave alcohol. Later on during the day, hallucinations like the nightmares of the night come to him, in spite of the fact that he is wide awake. He may succeed in fighting them down for a few hours, but ultimately he is overpowered and horrors reign supreme.

In the usual form of the disease, recognizable symptoms appear after two days or more. The patient is at first quiet, submissive, and his condition may even resemble mild shock. His mind is changeable; impressions last but a few moments and frequently the patient fears that he is going to die. He is anxious to comply with the wishes of his doctor or nurse, carries out orders, but sometimes with violence. He is restless and nervous, tries to get out of bed, and insensible to the pain it may cause him, attempts to walk around in an effort to get away from the hallucinations of fear, persecution, or what nots, which are torturing him. His mind is in a chaos of ever-changing ideas. He talks incessantly, the subject of the conversation with himself being a combination of delirious ideas and fanciful notions of things and people about him. He recognizes his friends for a while, but in the uncontrollable, vivid and dreadful hallucinations he soon ceases to know anything or anybody, and regards all people and objects as taking part in his persecution and final destruction. He may fight or injure himself and others in his violent efforts to evade torment. In his panic, he moans, mutters, curses, cries, shouts or prays. He looks fearfully about, suspicious of everybody and everything, and listens as though he heard sounds or voices. He sees objects which appear multiple. These take the forms of various animals, such as snakes, rats, and dogs. In this stage, the patient is obviously physically sick. He is entirely sleepless, perspires freely, the limbs tremble, the head shakes, and the muscles of the face twitch, the pupils are widely dilated and the tongue, which is heavily coated, quivers. As the delirium increases, the tremor abates somewhat. Finally, after many hours, even days of torture, the patient becomes stuporous, the heart rate gradually diminishes, and after a period of weariness and relative quiet, the patient falls into a deep sleep which lasts from twelve to thirty hours. Following this, he becomes cognizant of his surroundings, the hallucinations are gone, and the orientation is complete, still the mental condition is not quickly restored and for several days, the patient is unable to correctly concentrate his thoughts.

In some men there is a reappearance of the delirium during the night, while during the day they remain free. In such patients, any excitement causing mental exhaustion may bring back some of the hallucinations.

A good routine preventive treatment has been suggested by Maxwell,[7] it consists in giving a dram of paraldehyde in an ounce of whiskey every four hours alternating with 15 grains of veronal. Such treatment is carried out on every patient where there is danger of delirium tremens, and, particularly, in those alcoholics in whom an operation is performed without adquate preparation. It is kept up until a sound sleep which lasts twelve hours is secured. Just as soon as the patient can go to sleep readily, the sedatives are stopped. It usually takes about two days to accomplish this. The treatment is not commenced for eight hours after an operation because of the condition of the stomach.

In alcoholic cases, most thorough elimination by kidneys, bowels, and skin is continued for two or three days before the operation if there is time for such preparation. In addition, forced feeding with large amounts of liquids is persisted in.

The treatment must be symptomatic.[8] These patients have often subsisted so long on alcohol with inadequate food that degenerative change in the heart muscle, arteries, stomach, and other organs have developed, hence danger is not so much in the delirium itself as in the diseased condition of vital organs of the body. In young alcoholics, the alcohol should be withdrawn, but in weak or elderly patients, it can be gradually reduced only. The stomach should be washed, if the surgical condition permits it, and a generous dose of epsom salts left in the stomach. The patient is put into a warm bath, or else sweating is obtained[7] by means of the hot-air bath or hot pack. Potassium citrate 25 grains, is given every four hours, as are large amounts of water by mouth, by rectum, and under the skin to aid the eliminative power of the kidneys. It must not be lost sight of, however, that the patient is to be treated as one having a degenerated heart muscle and no eliminative measure should be carried out which would likely cause sudden dilatation. The blood pressure must be watched closely and stimulants administered to the heart. Pituitrin is useful for this purpose. Strong coffee can be administered instead of the pure caffeine. Atropine is valuable in marked depression with pulmonary edema, cold and clammy skin, and it may also lessen the craving for alcohol.

In mild attacks, the delirium may be controlled by paraldehyde, 1 or 2 drams repeated every hour if necessary. Chloral in large doses, 30 grains or more may be given per rectum by olive oil.

Osler recommends a mixture of morphine (1/8 grain) with chloral (15 to 30 grains) and to these are added tincture hyoscyamus (1/2 dram) tincture ginger (10 minims) and tincture of capsicum (3 minims) water q. s., 1/2 ounce. This mixture is given every hour if necessary. The delirium is not cut short, but sleep is secured for some hours, which gives the needed rest to the overworked heart.

Intramuscular injections of ergot are also recommended. The solid extract is dissolved in one ounce of sterile water. Thirty drops of this solution are given every two to four hours. It tends to lessen the various congestions and bring about a better equilibrium of the circulation.

Recently, Leonard[9] has reported the results of giving intraspinal injections of magnesium sulphate in 12 cases of delirium tremens. Lumbar puncture was done, and varying quantities of the cerebrospinal fluid (10 to 40 c.c.) withdrawn, depending on the pressure. Following this, 1 c.c. of a 25 per cent solution of chemically pure magnesium sulphate to every 25 pounds of body weight was introduced through the lumbar puncture needle by means of a syringe. The treatments were given with the patient in sitting posture, but afterward he was put into the semirecumbent position. These patients required constant attention for twenty-four hours following the injection. Seven developed a paraplegic state in which they lost control of both sphincters. The condition appeared within forty-eight hours. Five cases had retention of urine with weakness in lower limbs and lessened reflexes. The temperatures in these patients rose to 101° to 103°.

Since the mortality is so high among such cases and since so little is accomplished at times with sedatives, Leonard feels that one is justified in using this treatment. The delirium and restlessness subside very soon following the injection, and the patient is restored to normal within twenty-four hours.

Food should be given every two or three hours during the period of delirium or when the patient is awake. Under no circumstances, disturb him if asleep. A little eggnog along with the food may be given in all cases, but in the aged or very weak patients, this is imperative.

Restraint is always bad form. If it is possible to have two attendants to watch the patient and keep him in bed, this is better than the use of any artificial means. If necessary, these remedies must be employed. However, every available means must be exhausted to assure the patient and to gain his confidence before any attempt at force is made.

During the convalescence, stomachics, such as ginger, capsicum or nux vomica may be given. Frequent warm baths and careful attention to the bowels, massage, early sitting up, calisthenics, fresh air and sunshine will enable the patient to leave the hospital a week or ten days after his attack of delirium if the nature of his operation permits.

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CHAPTER XXVII

POSTOPERATIVE PSYCHOSES

By O. F. McKittrick, St. Louis, Mo.

A surgical operation is almost always considered a tragedy. It should, in compensation for the mental and physical suffering incurred, be followed without delay by a period of comfort and of good health. It really becomes a tragedy when happiness does not appear, but instead new dangers and discomforts present themselves as a result of the operation to increase the gloom, and, finally, the reason becoming dethroned, the fruits of surgical labor are suddenly snatched away.

It has long been known that mental disturbances may follow operations. As early as the sixteenth century Paré considered a "spiritual calm," essential to the future well being of patients about to undergo one. It was not until the beginning of the nineteenth century, however, that postoperative mental excitation was first described by Dupuytren who called the condition "delirium nervosum." A few decades later, Herzog and Sichel, and many others reported cases of insanity following eye operations. In 1865, Van Courtney reported the first case of insanity following ovariotomy. Fifteen years later, Lossen and Furstner cited such an instance following hysterectomy. Since that time many observations have been made on the subject. Such papers, however, have appeared sporadically, and both in America and abroad, these are for the most part fragmentary, the authors merely reporting a case here and there.

Mental derangement of almost every degree and character has been described following surgical operations. It occurs most frequently in adults; in the female more commonly than in the male. Neither children nor the aged escape, though the usual period of life in which this serious complication makes itself known, is between thirty-five to forty-five years.[1] It is hardly possible to say just how often postoperative psychoses will occur. Many psychoses do not make their appearance until after weeks or months. In the series of forty cases reported by Kelly, the majority of the symptoms occurred between the second and tenth days. In eight instances they began almost immediately after the operation. In others, they did not appear for one month. Out of every 1000 patients who undergo laparotomy, four will go insane, according to Da Costa.[2] Of 5000 insane patients, Dewey found only 3 whose minds were sound before the operation. Of the milder mental disturbances which follow operation, Kelly found 50 after 13,000, while Mitchell reported 31 instances in 344 patients.

Psychoses are as common after mild as after severe operations. The anesthetic does not seem to make much difference, the condition occurring alike after ether, chloroform, or gas anesthesias. Instances occur even after local anesthesia as reported by Selberg[3] and also by Grekow.[4] It seems that most of the cases reported in the literature followed gynecologic or ophthalmologic operations. Picqué[5] very strongly insists that postoperative mental aberrations are no more apt to follow operations of this character than those on other parts of the anatomy. Indeed, Rohe found that out of 196 cases, 65 followed genital and 35 followed cataract operations, while 96 appeared as a result of operations on other parts of the body. Abdominal operation in which the ovaries are not involved do not particularly predispose to mental disturbances. However, removal of the ovaries or testicles is peculiarly provocative of this condition.

As to the forms of postoperative insanity, it is claimed that there is no one type. Clinically the term includes those varieties of mental aberration which are related to each other only in so far as they occur in a surgical convalescence. The condition ranges from a mild transitory mental disturbance to that of an incurable maniacal state. Some authors make no attempt to determine the special form of disease which has presented itself. Urbach[6] classified his five cases following 106 gall bladder operations as "acute hallucinatory confusional insanity." Others have noted melancholia, stupor, delusional state, hysterical excitement, morbid fears, delusions, hallucinations, etc., but probably the most common form is acute confusional insanity. It is characterized by confusion of thought and incoherence of speech, delirium, at times delusions and hallucinations, alternating with periods of stupor following the mental excitation.

There are many factors connected with a surgical operation which may prove fruitful as an exciting cause for insanity which appears at times during the convalescence. The patient may have suffered from severe pain, fear, sleeplessness or exhaustion. He worries more or less, and the operation is performed under a general anesthetic which leaves him unusually toxic. There is some loss of blood, and shock may appear after the awakening from anesthesia. There is postoperative pain with possibly attending insomnia, anxiety, concern, and even homesickness which is the last straw.

There is a predisposition, either hereditary or acquired in all cases of postoperative insanity;[2] the operation and all that is associated with it being only an exciting element which completes the overthrow of the unstable and predisposed nervous system. Histories[7] are not always reliable, since many patients are averse to giving correct details concerning this subject. Many observers believe that these unfortunate patients were in danger of insanity before the operation and would have probably gone insane anyway, sooner or later, when exposed to the chances, worries and changes of life, even had no operation been performed. Da Costa definitely states that a normal healthy individual will probably never go insane following any surgical procedure unless it involved the brain, removal of the testicles or the ovaries. Berkley[8] found that 60 to 70 per cent of those patients now in asylums show such a history, while Kaller,[9] studying the histories of 2273 patients in Switzerland noted 78 per cent with tainted ancestry.

Two very important factors concerned with these mental states are fear and worry. There is evidence in abundance to show that fear can produce all sorts of disturbances in the human mechanism. The patients, it is true, who come to operation, are usually outwardly calm, heroically firm and determined, some even happy at the prospect of being freed of their disease, but if one could fathom the innermost workings of their minds, in many instances, one would be astonished at the damage which this one factor alone has wrought, the harm having been done long before the time set for the operation.

In patients not predisposed to mental disorders, either by acquired weakness or by heredity, the danger of permanent mental disarrangement is not so great as in those not so handicapped. The operation over, the gloom which surrounds such patients lifts, and the worriment promptly ceases. In individuals, however, predisposed to insanity, there may be no rally at all even after an operation which promises a life free from the original cause of the trouble, but the condition passes from one of worry to one of actual mental unbalance which may deepen into an insanity incurable by any means within our reach.

The prognosis in the first class of cases mentioned above is very favorable, but in the second class, too favorable an outcome must not be expected. The prognosis in general according to MacPhail[10] is 60 per cent recovery, while Werth[11] and Ellbery claim only 50 per cent. Fillebrown[12] considers the outlook very bad for any patient in whom the mental disturbance is anything but transitory. In older individuals, especially those suffering from serious organic disease, particularly syphilis, a grave prognosis is always to be given.

Crile and his associates have shown good anatomic reasons why such conclusions are inevitable. He finds that patients and animals, which are victims of nervous and physical assaults, suffer practically the same degenerative changes in the brain cells. These cells increase considerably in size, and the cell membrane becomes broken, causing distortion of its shape. The reaction to Nissl's stain is characteristic. An increased amount of this stain is absorbed at first, then as the degree of damage is increased, the reaction to the stain diminishes, so that in the final stages little or no staining is found.

The nucleus, nucleolus and cell body having been broken down, a mere mass of cytoplasm alone remains and is incapable[13] of regeneration. The number of such cells destroyed indicate the severity of the lesion. Crile and his coworkers have found that the brain cells respond in the same way when subjected to overwork, infections, drug poisons, shock, fear or anxiety.

Just how the exciting factors bring about such changes in the nerve cells can not be entered into here. A more thorough study in recent years of disorders following operations is proving its importance in that they are rapidly becoming an avoidable calamity.[14]

It goes without saying that before any operation, the patient should be known to the surgeon. A thorough history is almost indispensable. If there is insanity in the family or if the patient himself has a history of having been temporarily insane, an operation certainly exposes him to very distinct danger of another attack. None but the most urgent operations are justifiable in these cases and the risk should always be explained to the family. In highstrung or nervous individuals, and most patients become nervous in view of an impending operation, the surgeon must maintain a constant attitude of optimism and encouragement, he must never lose sight of the fact that the patient is to be inspired with confidence. Neurasthenics, if such patients exist, are always bad risks and operations on them should be avoided if possible.

If the patient develops symptoms of this dreaded condition after every effort has been carried out to lessen worry, fear, surgical trauma, etc., treatment must be instituted at once.

Probably it would be of importance in this connection to mention the following case history:

No. 6056, Miss J. C., 29, saleslady, two sisters insane. Patient was admitted for goiter operation. Swelling in the neck had started 5 years ago and gradually increased. No symptoms of toxic goiter until one year ago when tremor, nervousness, palpitation, and tachycardia were noted. These had gradually increased until she presented a typical picture. She complained principally of headache which had been more or less present during the past two months, but showed no other symptoms worthy of notice, except the fact that she was peculiar and did not always answer questions willingly.

She was put to bed, a pitcher of water was placed at her side and at least 1 glassful every hour was given her throughout the day. Sodium citrate (20 grains) with one dram of sodium bicarbonate were given three times a day for the first two days. The headache was stopped with aspirin (10 grains), still she was unhappy and worried. Very little shock followed thyroidectomy.

The convalescence continued uninterrupted and the patient's mind was clear for four days when she became morose, despondent, and wished to die. During this day and following night, she was irrational, worried, had frequent crying spells, refused to answer questions, and complained of headache.

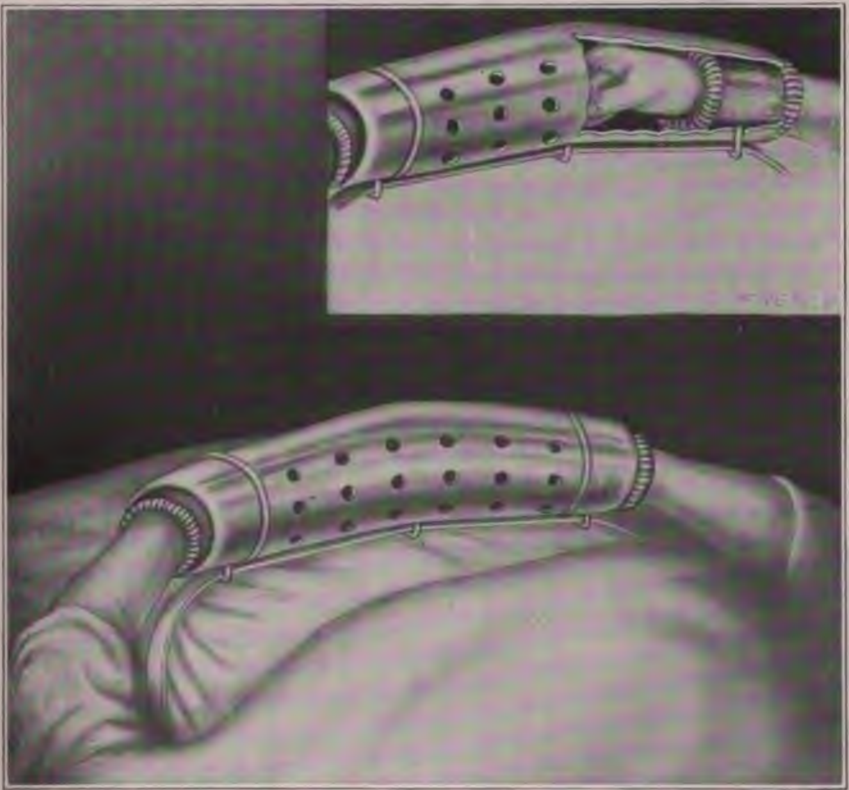

Fig. 28.—A method of confining the hands used at the Minnesota State Hospital, Rochester.

Early the next morning 800 c.c. of salt solution were given hypodermically, were repeated in six hours. She slept all the following night but the next morning in addition to previous symptoms, became exceedingly stubborn and refused to eat. During the next day, she slipped out of bed and roamed over the hospital. She was brought back and carefully watched while 10 grains of aspirin with one grain of codeine stopped her headache and gave her a good night's sleep. Next morning she insisted upon getting out of bed, complained bitterly

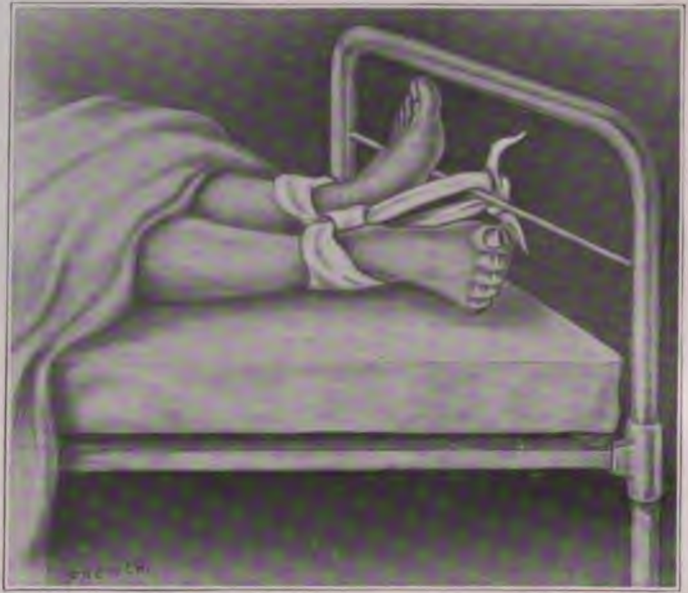

Fig. 29-A.—A simple method of tying the feet, which allows the patient to sit up in bed.

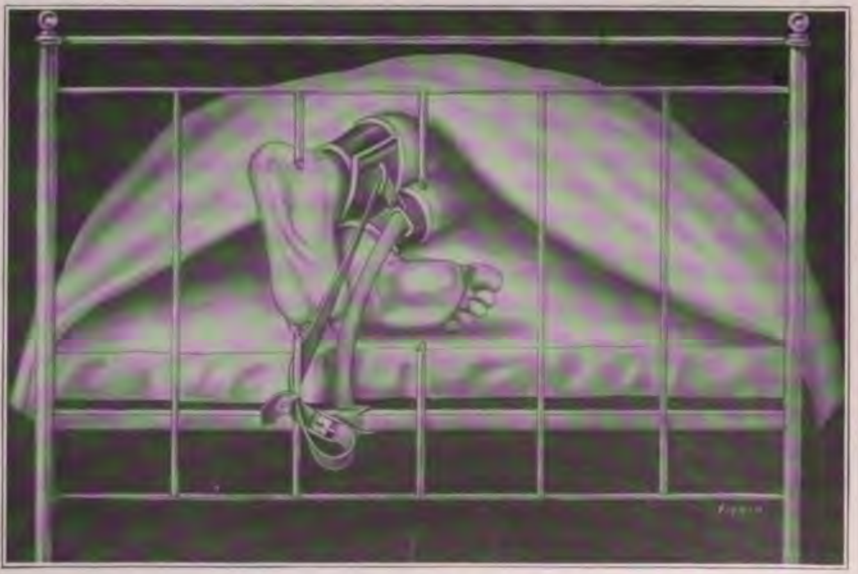

Fig. 29-B.—A useful leg cuff and strap which permits patient to sit up in bed.

of mistreatment, started to cry, talked irrationally, and remained very morose and refused food. Two days later, 2000 c.c. of water were given hypodermically at one time, which at once stopped the mental excitation, the patient remained quiet throughout that day, and slept well that night.

The following morning, she expressed fear of having to go to the asylum with her sisters, and later, tried to escape from the hospital, making it necessary to strap her wrists, Fig. 28. Her breakfast was given her by force, after which she became very obedient, ate her meals willingly, did not object to the straps, and the wound healed perfectly. On the ninth day the straps were removed and at the first opportunity she got out of bed again, wandered about, and became so violent and unmanageable that in addition to strapping her hands, it was also necessary to strap her feet. (Figs. 29A and 29B.) All the preceding symptoms returned, she refused to eat, became morose, and complained of severe headache once more. Her pulse, blood pressure, and temperature remained about normal throughout all the attacks. That night she slept well, having been given 10 grains of aspirin and 1 grain of codeine.

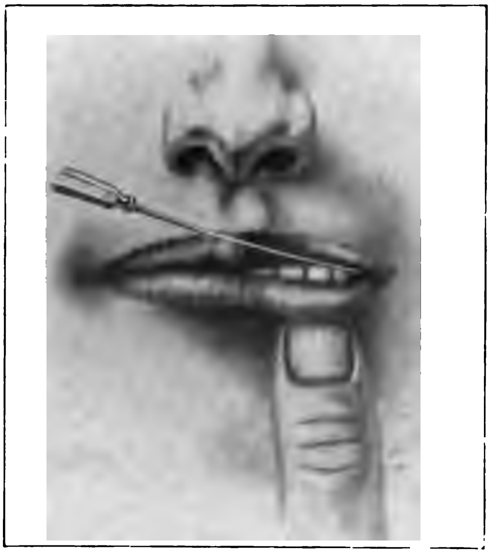

Fig. 30.—Method of forcing the mouth open for the purpose of forced feeding. Long flexible probe being passed between the teeth and cheek to the last molar tooth. (See Fig. 31.)

Next day the patient was again docile, ate her breakfast, and no outbreaks occurred. Later in the day, she was put in a chair without restraint and during the four succeeding days, she remained quiet, but the condition of her mind did not improve. An alienist pronounced it delusional insanity, and on the twenty-first day she was sent to a private asylum.

Most thorough eliminative measures must be attempted in these cases, all the water and alkalies the patient can tolerate being given by mouth, in the rectum, and under the skin. Large amounts of salt solution or plain distilled sterile water given subcutaneously will often relieve the symptoms and give the patient rest and sleep. It may become necessary for want of attendants to restrain the patient, which should be done only when absolutely necessary, the instruments used being so made that he can not injure himself. Food must be regularly given with sufficient alkalies to keep down an acid intoxication. Difficulty in feeding these patients may be so great that the stomach tube (Figs. 30, 31 and 32), must be resorted to. As to the drugs which may be necessary, bromides are very depressing and should be avoided. Opium and hyoscine particularly may be employed. We have had little occasion to use either when the water and alkali treatment is persisted in. The alkalies are given until the urine becomes neutral or alkaline. When such measures do not correct the malady an alienist should be called and the further treatment directed by him.

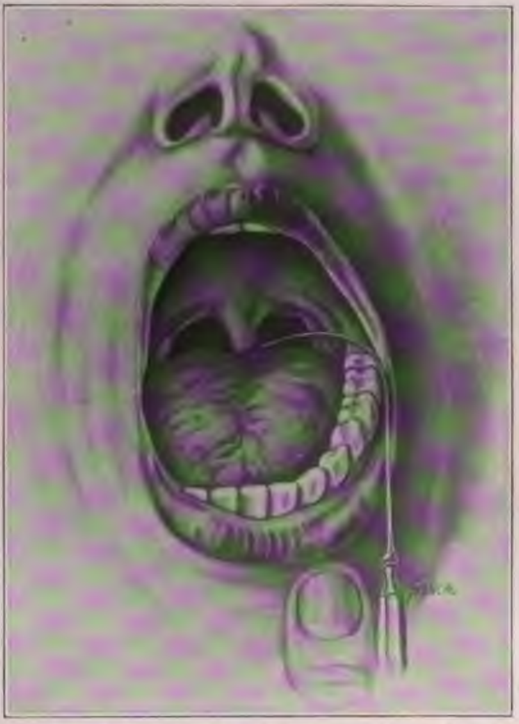

Fig. 31.—Showing the probe passing behind the last molar tooth and tickling the fauces, thereby causing immediate opening of the mouth. A soft pine stick containing a round hole is immediately placed between the teeth as shown in Fig. 32.

The patient should not remain long in a general hospital. As soon as the surgical convalescence has been completed, he ought to be moved to a private sanitarium or to his home as thought best by the medical man in charge. Hygienic measures are particularly important, sunshine and fresh air with clean beds, frequent warm baths, and other measures necessary to prevent bed sores, are indispensable.

The surgeon should keep accurate records of such cases and have ample testimony as to what condition the patient was in before and after the treatment. Where the patient suffers from a delusion of persecution, some of these imaginable wrongs may so impress her during the saner moments as to acquire forensic importance and be the subject of serious legal inquiries. While every effort is put forth to help the patient, the surgeon must at the same time make ample provision to protect himself.

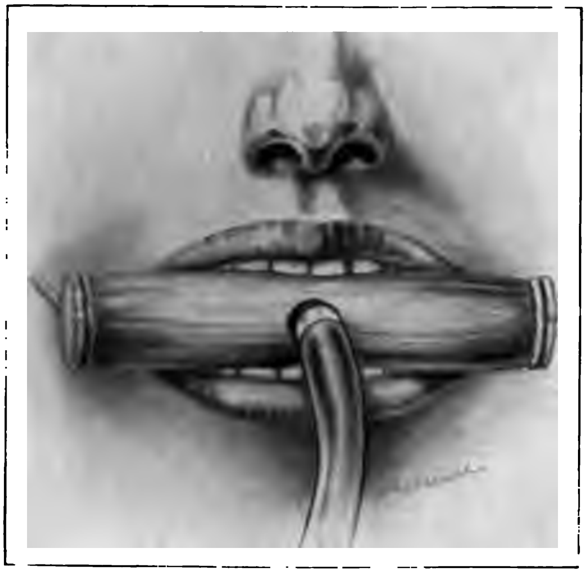

Fig. 32.—Showing round soft pine stick tied in position between the teeth. The round hole in the center of the stick receives the feeding tube. The patient is thereby prevented from injuring himself and compressing the feeding tube, and consequently can not further resist the proffered food.

Febrile Delirium

Among the other conditions which may be confused with insanity is febrile delirium. This term has arisen because of the fact that most of the general diseases which cause delirium are febrile. Delirium in itself denotes a state of mental excitement, which comes on suddenly, is only temporary, and is due to a recognizable cause. The mental manifestation differs in no essential way from some of the acute insanities, but it has become customary to restrict the application of this term to certain intoxications, to great exhaustion, or to emotional instability, as in hysteria, etc., to organic disease of the brain or to infections.

Very high temperatures frequently cause delirium, as do also disturbances of the cerebral circulation, but the effect of the toxic substances in the blood is found to be the cause in the majority of these instances. Delirium does not always follow a high temperature, this condition being seen at times in patients with very little elevation of temperature, as is the case in children or in old people.

According to Da Costa, delirium in septic cases usually makes its first appearance in the evening when the patient is between waking and sleeping. It is apt to clear upon becoming wide awake only to reappear when the patient becomes drowsy again. After disturbing the patient throughout the night, it will clear up towards morning only to manifest itself later on during the day. Acute mania does not clear up as does delirium, and there is no true lucid interval in the former condition. The onset is not so rapid in mania nor is the degree of illness so intense.

In confusional insanity, the same symptoms may be seen as in delirium, and these conditions are easily confused. However, febrile delirium occurs during the febrile malady rather than following it as is seen in actual insanity. The treatment is the same as for post-operative psychoses.

Delirium Nervosum

Delirium nervosum is a term which has been used to describe a condition occurring within the five or six days following an operation, in very nervous people. This condition may follow injury, and hence it is designated, by some, traumatic delirium. Usually there is maniacal excitement though in some of the patients, melancholy depression, confusion, or even revelry with subsequent stupor, are the most prominent symptoms. The mental excitement seen in true delirium nervosum has a sudden onset. The condition lasts several days and ends just as suddenly as it came. In such a malady, hallucinations, illusions and delusions occurs. The condition is apt to be confused with confusional insanity, and, in fact, the form with confusion and a tendency to stupor is really an insanity. However, a diagnosis of delirium nervosum is not made until it is certain that the condition is produced by sepsis, acidosis, uremia, etc. The patients usually recover if it is purely a nervous phenomena, though at times a patient dies in what is diagnosed as this condition.

Senile Delirium

Old people do not stand operations well. Many of them sleep badly and are apt to be irritable, restless, excitable, quarrelsome, and even suspicious. In such a state of mind and subjected to the dangers of an operation the aged are predisposed to delirium. No sign of mental deterioration may have been noticed before the operation, though soon afterward grave signs of this complication may develop, and mania, melancholia or delusions arise, which unfortunately, may be the precursors of senile insanity.

It is common for such individuals to develop delirium during the night, but the daytime is not always free from the malady. An elevated temperature may occur or may not depending largely upon the condition for which he was operated. When he wakens after the anesthesia, or perhaps hours later, the patient becomes irritable, suspicious, restless, inattentive to his surroundings, and soon passes into a state of delirium. He talks and shouts, tries to get out of bed, and if at any time he does succeed[3] wanders off. Frequently there are hallucinations of hearing, and in his excitement from these or other hallucinations, suicide may be attempted. He may become erotic, and commonly he urinates or defecates in the bed. Such delirious conditions soon pass away unless a part of true senile dementia.

Hysterical Delirium

Hysterical delirium is seen in young women at times after an operation. It is most common at the menstrual period. The condition is precipitated by fright, overstrain, worry or any violent excitement. It begins suddenly, being preceded by convulsions or these may not occur at all. The patient becomes extremely excited, is very restless, talks loudly *but not incoherently,* and becomes very obstinate. She will probably cry, scream, lament, implore, and do anything to attract attention and pity. She is perverse and is apt to make indecent exposure or use obscene and profane words. It seems that the excitement comes in waves and during a lull, the patient may suddenly ask intelligent questions or act normally. The whole condition is one of unreality and strikes one that the patient is *pretending* to be out of relation with her surroundings. The excitement usually ends after an hour or possibly after several hours, following which there may be lacrimation. In such patients, the visual fields should be examined and the areas of anesthesia which are commonly found in hysteria, sought for.

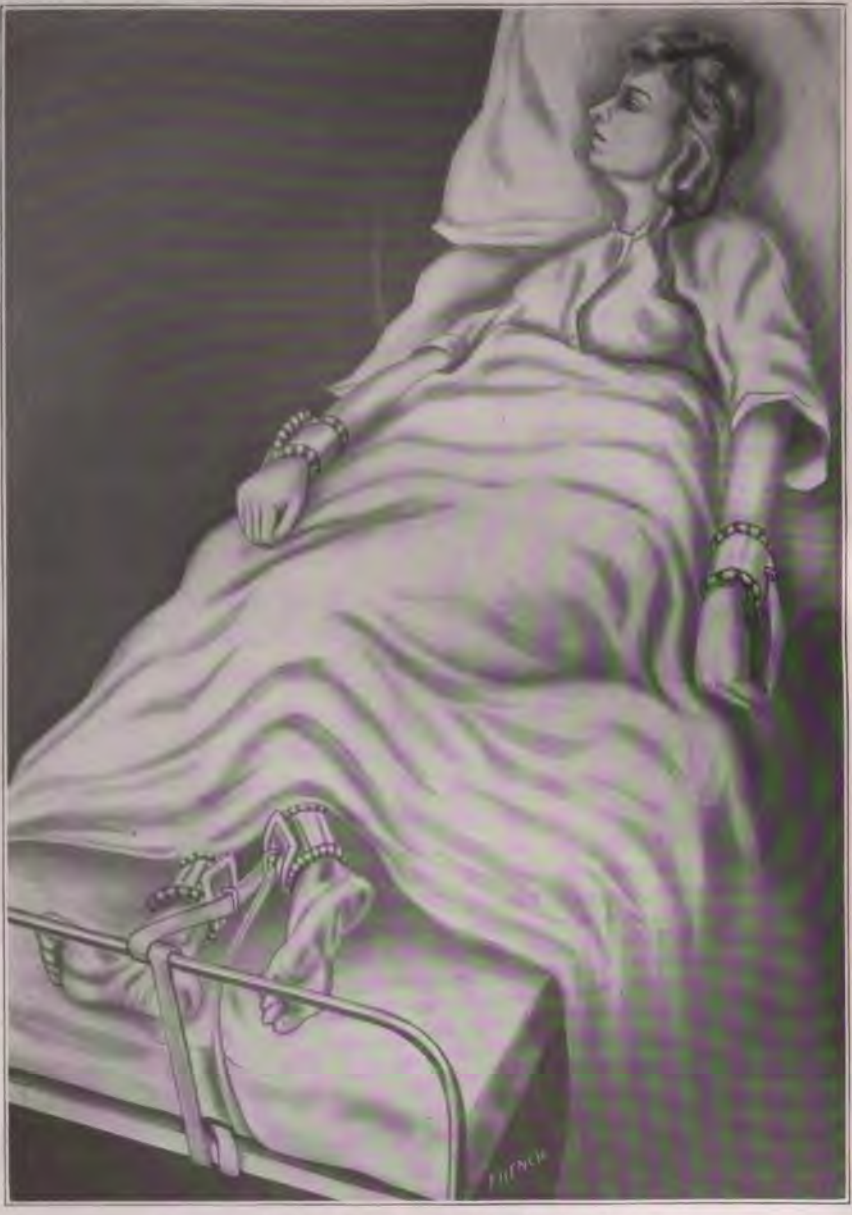

Fig. 33.—A simple scheme for restraining hands and feet only.

Other conditions which cause delirium and which simulate insanity can not be too thoroughly studied. Delirium following drug poisoning, delirium of starvation (as in cancer of the stomach or esophagus), of collapse, of fatigue or of delirium following acidosis, uremia or diabetes must not be confounded with insanity. It would prove a serious mistake to call such conditions as have been named, beginning insanity or to state that some organic brain disease is causing the mental excitement when some minor factor, at times easily diagnosed, is the sole cause. On the other hand, it is a serious blunder not to recognize those who are actually insane and not to have them cared for in a proper way.

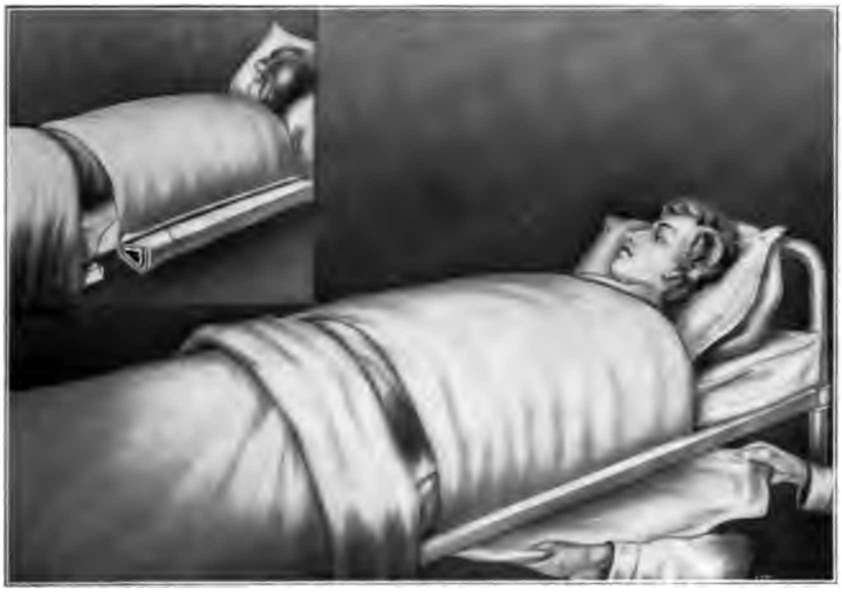

Fig. 34.—Showing the method of restraining the body by means of a sheet, the end of which is tightly pulled under the bed railing and rolled around it as depicted in the insert.

The treatment should carry with it every method which will aid efficiently in preventing the patient from injuring himself. Restraint (Figs. 33 to 36) is used only when absolutely unavoidable. We have found it a good rule to give, in such cases as in the real insanities, a large dose of water and an alkali. A subcutaneous injection of 2400 c.c. of water at one time will aid materially in quieting a delirious patient. Sodium bicarbonate and sodium citrate should be given by mouth and per rectum. These should be kept up until the urine becomes alkaline. The former drug is given 60 grains every four hours while the latter drug is usually administered in 20 or 25-grain doses in same length of time.

Ice is applied to the head and warmth to the feet. The bladder and bowels are kept free and diaphoresis is encouraged.

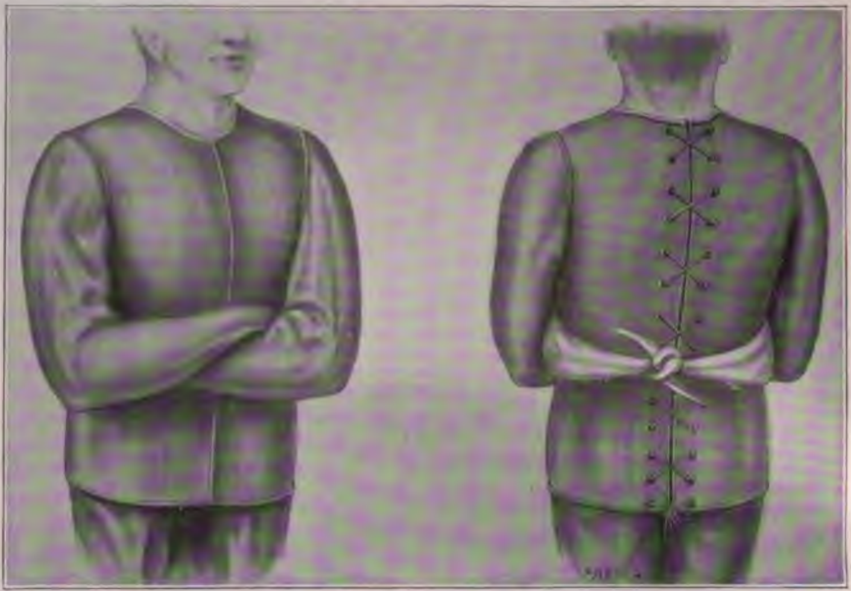

Fig. 35.—An admirable straight jacket with comfortable hand arrangement for walking insane patients, Minnesota State Hospital, Rochester.

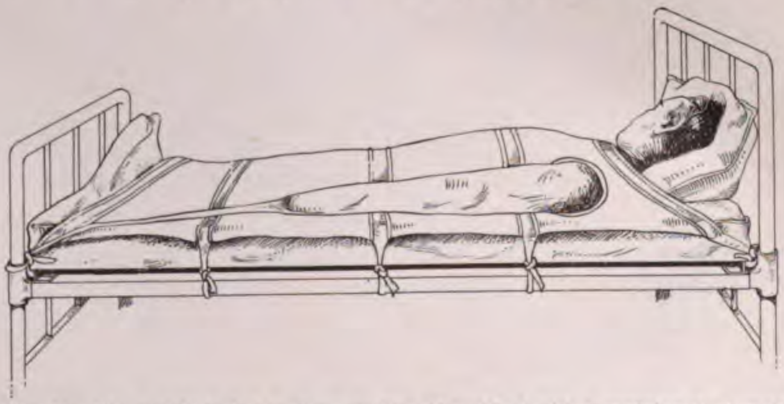

Fig. 36.—The straight jacket as shown in Fig. 35 combined with a confining sheet, making an absolute restraint for uncontrollable patients. The three straps over this sheet may be of canvas or leather.

Dr. Stuart McGuire gives the following instructions to patients suffering from *postoperative neurasthenia* when they are discharged from the hospital.

Your wound has healed and requires no further attention.

The operation has removed the cause of your trouble, but it will take some time for you to get well.

When you get home you should put yourself under the care of your physician. He knows all that was done for you and all that was learned about you while you were in the hospital.

Don't continually think about yourself and ask yourself how you feel. You don't know enough to tell whether a symptom has any significance or not. You employ a doctor. Let him do the worrying for you.

Don't worry yourself. Worry is thinking to no end. "Distracted" means drawn two ways. Worry and distraction prevent rest and sleep and result in chronic tiredness.

The cure for worry is concentration on something with an end in view. To be wholesome that something must be productive. In other words, you need occupation.

While at the hospital you had a "rest cure." You now need a "work cure." Try to find some light, useful work that will occupy and interest you.

At meal times put aside care. Don't be afraid to trust your digestion. Don't abuse it, but use your stomach confidently.

Keep the bowels open by natural means such as a proper diet, an abundance of drinking water, a reasonable amount of exercise and a habit of going to stool at a regular time. Mild laxatives may be necessary occasionally.

Avoid stimulants and hypnotics unless prescribed by your physician.

On getting up in the morning take a cold sponge bath. On going to bed take a warm tub bath. Sleep with the windows open.

Rest in a quiet room for one or two hours in the afternoon.

Spend as much time in the fresh air and sunshine as your strength and the weather will permit.

Increase exercise as you gain strength, stopping when you get tired and not going until you get exhausted.

Please report your condition by mail at the end of three months. If you are doing well the information will help us, if you are not doing well we may be able to help you.

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CHAPTER XXVIII

ACID INTOXICATION

By O. F. McKittrick, St. Louis, Mo.

Acetonuria is of such frequent occurrence in postoperative convalescence that it is incumbent upon me to give it extended mention.

Its importance is manifested by a symptom-complex of greater or lesser severity, depending upon the amount of retained acids in the body, which condition, for want of a better name, has been termed "acidosis." The degree of this de-alkalinization of the body fluids or acid intoxication may become so great as not only to cause most severe symptoms, but even death, in fact this one complication alone is claiming its victims by the thousand.

General anesthetics came into use about the middle of the nineteenth century, and while from the start success attended their use, there soon was noticed a factor which up to this time had never been called to the attention of the experimenters in this field. This new factor appeared two to three days after the narcosis in the form of a profound intoxication, at times accompanied with incessant vomiting. As anesthesia became more general just so did this new condition increase in prominence and severity. An explanation was not forthcoming, and since these toxic patients frequently died in coma, the condition was thought to be diabetes. As fate would have it, the first discovery of acetone was made in a diabetic patient. After this discovery by Peters[1] in 1857, it was repeatedly demonstrated by him in other severe cases of diabetes. Soon thereafter Kaulisch[2] found it present in varying quantities in all stages of this disease, and first described the symptoms of acidosis which was then termed acetonemia. Kussmaul[3] in 1874 in describing diabetic coma mentioned the likely importance of the toxic action of acetone as a causative factor. During this time chloroform was the popular anesthetic, and many deaths occurred in which the symptoms of acid intoxication were noted, but the deaths were attributed to other causes. Such cases were reported by Casper, König, Volkmann and others. Kast and Mester[4] in 1891 studied the urine in these cases and found among other things hyperacidity. In 1894, Becker[5] working along the same lines but in addition examined for acetone the urines of about fifteen hundred healthy individuals before and after operation and found a pathologic amount in over 60 per cent of the cases following narcosis; three fatal cases being reported by him. During this same year Guthrie[7] reported nine more fatalities. A year later Stocker[6] added another case to the list. Other cases were reported from time to time, but in each one chloroform was given as the cause of death.

Brewer[8] in 1902 first reported a fatal case which without a doubt was due purely to acid intoxication, in a patient free of diabetes. Two years later Bracket, Stone, and Low[10] cited several instances of acid intoxication in nondiabetic patients and gave an exhaustive study of the whole subject. After this work operators seriously considered this possibility and henceforth acidosis assumed clinical importance. Bevan and Favill[11] in 1905 reported one case and collected 28 more of acid intoxication following chloroform narcosis. One year later Beesly[12] reported 17 cases in which he mentioned acute and chronic acidosis. Later on Campbell[13] and McArthur[14] each reported fatal acid intoxication following chloroform anesthesia. In 1908 Rice[15] found an excess of acetone in the urine following ether narcosis in 90 per cent of 202 patients who were not diabetics. Of 214 cases reported by Bradner and Reimann[16] in 1915 a pathologic amount of acetone was found in 61.7 per cent of them following ether. In 17 per cent diacetic acid was present, but always in association with large amounts of acetone.

It has long been known that acetone occurs in minute quantities in the urine and blood of normal individuals. This materially increases in amount in fevers, wasting diseases, insufficient carbohydrate diet, and particularly following anesthesia. The amount of the anesthetic, the length of time given, and the kind of operation apparently have no bearing on the extent of the intoxication. It appears after local anesthesia in a high percentage of cases as Gellhorn[17] has recently shown. It occurs more often in women than in men, and is as frequent, in the infective diseases in children, as is fever itself.[18]

The formation of the acetone bodies (betaoxybutyric acid, diacetic acid, and acetone) is due chiefly to fat metabolism, with the formation of free fatty acids, and is largely dependent on a reduction of the carbohydrate and protein diet, also in general subnutrition.[19] Where acetonuria is found clinically, there is often an intestinal disturbance which results in a defective nutrition of the body, associated with waste of the adipose body tissue.[19] It follows, then, that the fat which breaks down may be the food fat or as is usually the case, the body fat. But at any rate the immediate cause of the appearance of a pathologic amount of these bodies is the disturbance of the metabolism.

Experimentally acetone is readily formed from fat or carbohydrates. Blumenthal and Neuberg[20] produced acetone from gelatin and it is probable that it may be obtained from protein.

The first observers thought acetone might occur from breaking down of the proteins, but this was discouraged by von Noorden, Honigmann and others. Recently, however, the question has again been raised by Chapin and Pease[21] who have demonstrated an acidosis in children from feeding a protein diet in gastrointestinal diseases.

Just why acid intoxication develops is a question which has not been definitely decided. An acetonuria does not denote an acidosis though it may be the forerunner of an acid intoxication. This phase of the condition has been studied by von Jacksch,[22] Baginsky,[23] Lorenz[24] and many others. Baginsky in 1888, showed that the severity of the symptoms were dependent upon the height of the fever and the kind of food allowed. He considered it a disturbance of metabolism. Lorenz in 1890, while agreeing with Baginsky, thought that gastrointestinal disturbances were the primary factors in creating this unnatural condition. Chapin and Pease,[21] hold that through such disturbances the epithelium of the intestinal tract is so damaged by the acids or bacterial products thus produced that the toxins penetrate the membrane. Under such conditions the salts of the food may pass into the blood in such concentration as to act as poison to the body cells. Water is consequently withdrawn, and this produces the thirst so commonly observed in acidosis. These abnormal acids demand an increase of alkalies, which necessarily causes a diminution of them in the blood. With the lowering of the alkalinity of the blood the body cells are damaged and the nitrogen output is thereby increased. Extensive withdrawal of the alkalies and water may permanently damage the body cells with the result that loss of weight, and in infants, malnutrition and even atrophy occur after an acid intoxication.

Howland and Marriott[25] have tried to find an explanation for acidosis in the retention by the kidneys of acids which are the product of metabolism. In support of this view they call attention to the lessened urinary output and suggest that this may be due to the loss of the acid excretory function. As has long been known there is an increase in the watery content of the stool, during diminution of the urinary secretion. Experimentation is now being carried on to prove this theory, but while we await the result we are as far away from a solution of this problem as were those men of a half century ago.

It must be remembered that the body is constantly elaborating acids as the result of oxidative processes in intermediary metabolism and in order to neutralize these acids there is maintained a certain alkali reserve in the blood. It is derived from the sodium bicarbonate in the plasma and in the corpuscles. The acid and alkaline phosphates of sodium and potassium are found in the red cells, and the proteins. These constitute the defenses of the animal organism. In addition there is a further defense in that ammonia can be produced and utilized to neutralize acids when these appear in excessive amounts; the whole being under the control of a central nervous mechanism.

Anything which tends to break down these body defenses predisposes to acidosis. Lorenz long ago showed that fright or hyperexcitability was indeed a fruitful cause of this condition. Bracket, Stone and Low, also found that homesickness, nervousness from too long confinement in the hospital or the excitement of seeing other patients recover from the intoxication of an anesthesia, was a predisposing cause. Other causes outside those already mentioned are chronic diseases of the liver, exhaustion from hemorrhage, starvation, fatty degeneration of the muscles, as may occur in paralyzed limbs, and a lowered general vitality as in sepsis, or diabetes.

As a rule the symptoms of acid intoxication following operation appear in from one-half day to six days, though the elimination of acid bodies, however, ceases within three days. As was shown by Wilber[26] in 1904 and again recently by Marriott, the severity of the symptoms is not dependent upon the amount of the acetone bodies present and a most severe intoxication may be seen without any material increase in these bodies. Keller[27] and others have sought in vain to find other abnormal acids which would account for the symptoms. In view of the above facts one should not overlook these cases of intoxication because merely a slight trace of acetone is found in the urine and because the acetone bodies in the blood have not increased at all.

The patient usually complains of being sick, "so sick all over" and begins to vomit a day or so following the operation or the nausea and vomiting from the anesthetic may not as yet have ceased. He is irritable and restless. The appetite has not reappeared and the breath has a sweetish fruity odor. The symptoms may be mild and pass away in a few hours. In very severe cases the patient not alone complains of being sick "enough to die," but looks it. The face becomes ashen gray, the lips pale and dry, the eyes sunken and glassy. The skin is moist and cold or in some cases is hot and dry and the patient may become jaundiced. A temperature from 100 to 103 is likely to be present with a rapid weak pulse. During this state of collapse delirium may be noted, even followed by convulsions between the paroxysms of vomiting. Usually apathy and stupor will be noted later. This quiet does not last long and the patient again becomes restless and active in his delirious state. As the condition increases in severity, the victim passes into a stupor which deepens into coma. The respiration becomes difficult and finally takes on the Cheyne-Stokes type, the heart weakens, and the patient dies without regaining consciousness.

Many observers have described a type of acid intoxication which comes about four days after operation, appearing suddenly in patients, particularly children, in whom the convalescence had given no reason for alarm. The sick one suddenly becomes irrational, wildly excited, and uncontrollable. Under powerful medication he may quiet down, only to start up again with a piercing shriek followed by agonizing moans, he soon develops the symptoms noted above and frequently is dead in thirty-six hours.

Space does not permit a description of the various tests for acetone. Sellards[28] by removing the proteins from the blood serum with absolute alcohol titrated the filtrate with phenolphthalein. Under normal conditions a deep purple is seen, but if acidosis is present, the color is much lighter or even absent. Howland and Marriott have described a very accurate method of diagnosing acidosis, particularly in children, by determinating the carbon dioxide tension of the air in the alveoli of the lungs. An increased acidity of the blood stimulates the respiratory center to increased activity in order to reduce the carbon dioxide, so that the hydrogen-ion concentration may be kept at a normal level. The carbon dioxide tension in the alveolar air will be the same as the carbon dioxide tension in the blood. Van Slyke more recently has elaborated a method by which the carbon dioxide tension of the blood may be determined. These methods are the most accurate we have of determining an early acidosis.

A simple method of determining acetone in urine is that described by Lange.[29] "About 15 c.c. of urine are placed into a test tube and treated with 1 c.c. glacial acetic acid. To this add a knifepoint of ground sodium nitroprusside, dissolve by turning the test tube up several times. Now overlay with strong ammonium hydrate. In the presence of acetone an intense violet ring appears at the line of contact. The test will show acetone in $\frac{1}{400}$ per cent solution."

"Diacetic acid is tested for by adding an excess of 10 per cent ferric chloride to about 20 c.c. of urine in a test tube. The precipitate which forms is removed by filtration. To the filtrate add more of the chloride. A deep Bordeaux red color will appear in the presence of diacetic acid. The contents of the test tube are now halved and one portion boiled, and compared to the one unboiled. The color lessens due to the breaking up of the diacetic acid. The test indicates .04 to .05 per cent of diacetic acid.''[30]

To anticipate this mystifying disorder it is very important to institute measures of prevention. Such measures were carried out with some degree of success by Wallace and Gillepsie.[31] Their example was soon followed by Brown.[32] Since then many men have been active along this line, notable among them being Crile,[33] with his well-known "anoci-association.'' Recently Quillian[34] has reported the reduction of the occurrences of acidosis by carrying out a routine pre-operative treatment. I have for some time given my patients sodium bicarbonate one-half ounce in water three times a day half an hour before meals for two days preceding operation. Glucose is given per mouth as much as the patient will take and a glassful of water every hour or so up until within an hour of the operation. In addition every effort is made to assure the patient and get him accustomed to the surroundings. His habits and mode of living are disarranged as little as possible and nothing is allowed to occur which would in any way cause excitement, or concern. The nights are spent in quiet, bromides being given to insure quiet if necessary.

In spite of every preventive measure, acetone may appear as in fact it does in the great majority of patients. Following the anesthetic then in such cases water is started by mouth as soon as the patient is able to retain it, and after a day or so a pitcher is put by the bedside and the patient encouraged to drink a glassful every hour or two. Continuous proctoclysis is kept up for twenty-four hours, plain tap water containing glucose to the amount of 2 per cent being used. An ounce of sodium bicarbonate is added to each quart of proctoclysis, while sodium bicarbonate is given per mouth. Others have advised an enema containing one ounce of olive oil and one ounce of glucose in one pint of tap water, two hours before operation, the whole to be retained throughout the operative procedure. In cases where a violent condition demands more alkalinization, a 2 per cent solution of sodium bicarbonate in plain sterile distilled water is given in a continuous subcutaneous injection. Marriott would give intravenously a 4 per cent solution. Five per cent glucose may be given under the skin in the same solution with the alkali. Morphine pushed to the physiologic effect has almost a specific action. Carbohydrate feeding must constitute our sheet anchor and will be referred to more in detail in the chapters on feeding, etc. The time-honored custom of giving postoperative patients proteins in the form of broths, with no thought of their physiologic needs, has become so thoroughly ingrained in many of our hospitals that it will die hard.

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CHAPTER XXIX

DIABETES IN SURGERY

By O. F. McKittrick, St. Louis, Mo.

Glycosuria is a complication which is certainly not desirable in any surgical convalescence. Operations upon patients suffering from this condition are usually not performed without an attempt being made to determine the responsible factors which are bringing this about, and without medical treatment being instituted to correct the abnormality. It is frequently difficult in the presence of surgical necessities to distinguish between temporary or nondiabetic glycosuria and true diabetes. In fact, as early as 1884 Verneuil[1] stated that no one could definitely say where glycosuria ends and diabetes begins. The present day surgeons look upon sugar in the urine as a serious fact and do not try to differentiate such a finding from true diabetes. Instead, they have inclined to follow out a classification which was probably first suggested by Smith and Durham[2] which, though more or less modified, is about as follows: first, cases in which glycosuria is caused by the surgical lesion; second, cases in which the lesion causes the surgical condition; third, cases in which the two are independent and do not influence each other; fourth, cases in which glycosuria is a harmful factor and increases the danger of the already existing disease or injury.

Of the first class of cases it may be said that glycosuria is not uncommonly caused by the surgical lesion particularly in cases of injury or sepsis. Redard[3] suggested that they be classified as (1) injuries of the central nervous system; (2) cellulitis, lymphangitis, and erysipelas; (3) carbuncle; (4) gangrene; (5) septicemia; (6) injuries such as fractures and operations. To above other operators have added glycosuria as secondary to sloughing new growths, and certain other intraabdominal and intrapelvic diseases. In such cases the amount of sugar ranges from .1 to 2.50 per cent, is accompanied with a more or less albuminuria and an increase of the total twenty-four hour quantity of urine; these urinary findings being only transitory. Other diabetic symptoms such as thirst, itching skin, etc., were present in these cases. This condition as a consequence of appendicitis has been mentioned by Da Costa,[4] Leidy,[5] Cohn,[6] and others. In some of these cases the percentage of the sugar was as high as 2.5 per cent and usually lasted as long as there was any evidence of the disease. Imlach[7] reported a case of pyosalpinx in which all the symptoms of diabetes appeared with the occurrence of the disease and the patient was cured only by removal of the tubes. Strangulated hernias have produced a glycosuria. Neugebauer,[8] experimenting in an effort to find immediate cause of this complication in such cases, discovered that ligation of the vessels of the small intestines brought about glycosuria. Croom,[9] Beyea,[10] and others have noticed this occurring in patients having large tumors and have attributed it in many cases to the increased intraabdominal pressure. In Beyea's case, the tumor, an ovarian cyst, weighed 58 pounds, and 7 per cent of sugar was found in the urine. Glycosuria following gangrene has been noted several times in the literature. Phillips[11] in 1902 reported a severe case of traumatic gangrene in which the glucose reached nearly 4 per cent; this completely disappeared with the removal of the affected limb, which in this instance was the left arm.

Recently Konjetzny and Weiland[12] have found that in about 50 per cent of fracture cases there is a spontaneous or alimentary glycosuria, which like the above is only transitory. However, the symptoms of diabetes are not noted despite the presence of a hyperglycemia. The glycosuria appears at once or it may not occur for a few days but disappears at the end of from fifteen to twenty days. True diabetes rarely occurs; but, when it does, more than six months will have elapsed after the injury. Symptoms of this disease will persist permanently.

The actual cause of the glycosuria in these cases may be an anatomic injury such as fat embolism or a purely functional disturbance. Frequently it is a combination of both.

Regarding the second class of cases, "it is doubtful whether diabetes can directly cause any surgical lesion except vulvovaginitis, balanoposthitis and possibly cataract." The gangrene which occurs in diabetes, according to Phillips, is due to the arteriosclerosis or nerve degeneration which result from the constitutional disease. Carbuncle and other infections are to be regarded in the same light. The resistance being lowered in all diabetics, such patients respond very badly to any injury, surgical or accidental. The mortality from operation in such cases is still high in spite of the fact that newer forms of anesthesia such as nitrous oxide and oxygen, local infiltration and even spinal analgesia replace ether, while preoperative treatment reduces the amount of sugar. Seven patients with balanoposthitis were operated by French authors and one died from extensive gangrene, while of 102 operations for cataract Legendre found that 99 were successes.

From a surgical standpoint class three is the most important since here are placed the new growths, fractures and other injuries occurring independently in diabetics, and especially so since this disease may at the time of the surgical emergency be unknown, as the symptoms may be intermittent. Phillips reported 32 per cent mortality in operations on the face and mouth for malignancy which occurred in the presence of diabetes. Of the mouth and lip cases alone the mortality was but 25 per cent.

In operations on the breast there were 13.4 per cent mortality. On the genital organs 24 per cent, but in simple plastic operations the mortality was nil. The bad results were apparently due to infection which was of course facilitated by the lowered vitality of the tissues.

Abdominal operations including hernia, appendicitis, colostomy for malignant disease in Phillips collection of cases showed a mortality of 26.3 per cent. In operations upon the extremities the mortality was about 33 per cent. These cases included crush injuries, aneurysm neoplasm, and fractures.

Fractures occurring in diabetic patients are considered doubly serious since nonunion or delayed union is so apt to occur. Von Noorden[13] stated after a study of the researches of Toralbo, Van Ackeren, and Gerhardt, that diabetics often excrete an excess of phosphoric acid and lime salts over the quantity derived from the food ingested, and that they must come from the tissues of the body. Naturally this can only be from the bones, since an administration of alkalies causes a decrease in the excretion of lime; Gerhardt thought this was due to increased acidity. Of the cases reported by Smith and Durham more than 50 per cent showed delayed union or nonunion. Phillips cites other cases of nonunion, and while perfect union does occur, he thinks the former is more common. Von Noorden advised the giving of calcium carbonate to all these patients with fracture in an effort to supply the deficiency of lime. Such treatment carried out will no doubt decrease the number of delayed or nonunions.

The fourth class of cases includes those instances in which a septic element is already present at the time of the observation. It includes therefore gangrene, localized infections, etc.

The question of gangrene is an important as well as an interesting one. The so-called diabetic gangrene is now considered simply a gangrene occurring in a diabetic patient. Such a term is usually applied to gangrene occurring in the lower extremities. Considerable literature has accumulated on this subject, which has been complicated by the fact that senile gangrene is usually accompanied by glycosuria. Gussenbauer,[14] who has done extensive work along this line, advocates "diet and general palliative treatment first for this condition. The arteries must be carefully watched on both sides of the leg, and if the pulse can be felt distinctly in both the anterior and posterior tibial and dorsalis pedis arteries local removal of the diseased tissue will be sufficient. If, however, a pulse can be obtained in the popliteal artery only amputation of the leg below the knee may be performed, provided the gangrene has not spread beyond the dorsum of the foot and the leg is free of phlebitis and lymphangitis. If at any time in doubt, amputation must be done through the thigh." According to the Bartholomew Hospital Reports failure to recognize this rule carries with it a 75 per cent mortality.

Otitis media is common in diabetes, infection spreading up from the pharynx which is often in a state of catarrh. The onset is usually sudden and the pain is very severe and persists even though there is a free discharge through the external meatus. The discharge is very apt to be bloody and according to Eulenstein[15] there is great tendency to mastoiditis and necrosis. The disease may run a normal course, but in many instances an extensive cellulitis is present.

Cellulitis starting in the bursa olecrani which necessitated amputation of the arm is reported by Spencer, the patient recovering. Naunyn cites an instance of a large thoracic abscess which was soon followed by an abscess of the prostate. Following operation both abscesses healed without further complication. This case bears out Nicholas' [16] observations stated below that glucose favors the pyogenic properties of many microorganisms, while it diminishes their virulence.

It has been emphatically stated that the urine must be examined for sugar if after an operation the wound for no apparent cause becomes septic or sloughs. This is frequently found present although absent before the operation; it being a case of latent diabetes, sugar reappears after the general functional disturbance caused by the anesthetic or by the mental effects of the operation. It is well known that sugar when originally present is increased in diabetics under like circumstances.

In a septic process, which at times occurs in this condition, is found the Staphylococcus aureus and albus and other pus-producing pyrogenic bacteria. Even molds have been found in such cases by Auché and Dantec.[17] Bujwid[18] showed experimentally that an amount of staphylococci which did not produce suppuration if suspended in an indifferent though sugarless fluid, when suspended in a similar though sugar-containing fluid did produce it. He also demonstrated that no suppuration ensued if the injection of a subminimal amount of staphylococci into an animal were followed by the injection of normal saline fluid, whereas the injection of a sterile solution of sugar was attended by suppuration. If the sugar solution was withheld until the staphylococci disappeared from the blood, no suppuration resulted.

These experiments were substantiated by similar ones of Nicholas and Karlinski. In addition Nicholas showed that sterile water produced as much damage if injected into the cellular tissue as did the sugar solution. But if an amount of staphylococci sufficient to kill an animal in a few days was injected, and followed by a solution of sugar, either the animal was not killed at all or only after a much longer period, also a large abscess made its appearance instead of a small one or septicemia. Ferrero also agrees with these findings that sugar diminishes the virulence of microorganisms but increases their pyogenic properties.

From the foregoing data it will be seen that a majority of major operations have been and can be performed with success on diabetics. The percentage of mortality is 27.7 as reported by men who have collected the material on this subject. Such a percentage includes all kinds of cases which without glycosuria would give a high mortality. In ordinary cases in which there has been a preliminary treatment the mortality is hardly half this. Even in emergencies the percentage is not more than 20 to 25 per cent, the percentage of sugar is not always a criterion, since fatal results have followed from coma when sugar was temporarily absent, and cases with large amounts of sugar have recovered.[19]

The treatment of patients suffering with this complication must begin before the operation is started. The general treatment of the disease can not be entered into here, but while this is being carried out, the following rules as observed by most operators are important to remember.

"1. No operation save of the most urgent nature is to be performed if there is over one gram of ammonia excreted in twenty-four hours.

"2. Acetone and diacetic acid must be eliminated from the urine even if the ammonia is normal before a surgical procedure is attempted.

"3. Much albumin is a contraindication to operation and even a small amount is of bad prognostic import.

"4. Operation may be performed at once in cases of large pelvic tumors, where there is reason to believe the glycosuria is caused by the intraabdominal pressure, while in malignancy or in emergency operations a very guarded prognosis should be given."

During the operation the most rigid asepsis is carried out, and the operation finished as quickly as possible, under an anesthesia of nitrous oxide and oxygen.[20] In all operations which can be performed under local anesthesia, this is the procedure of choice. Ether and chloroform are to be avoided if possible.

The after-treatment includes the general measures for elimination. Large amounts of alkalies are given whether acetonuria occurs or not. Morphine and codeine must not be withheld and the diet should contain some carbohydrates, as too long and too strict exclusion of this food favors acetonuria. If the amount of sugar in the blood increases while that in the urine diminishes, sodium bicarbonate should be given at once intravenously.

Neuritis is a frequent complication in diabetic patients. In addition to making every effort to eradicate the sugar from the blood, massage and electrical stimulation is here indicated. Perforating ulcers which at times follow the neuritis are treated as in any other ulcer; the foot bathed frequently in warm water and kept elevated and exposed to an electric light which is contained within a screen which covers all.

Gangrene has already been mentioned. In diabetics particular care must be observed not to get hot-water bottle burns. The limbs must be kept warm and the blood circulating freely by massage. If sufficient warmth can not be maintained by this method, the electric light treatment will prove an efficient means of combating the difficulty. If amputation is indicated, the rule of Gussenbauer[14] mentioned above, must be carried out.

Pruritis can be controlled by frequent bathings followed by a lotion composed of glycerin, tannic acid and sulphurous acid ½ to one dram each to the ounce of distilled water. An ointment of 10 grams of menthol in an ounce of vaseline may be used instead.

The treatment of localized infections of the skin such as boils, etc., is discussed elsewhere (q. v.). Other complications such as albuminuria, digestive disturbances, etc., are treated by trying to eliminate the cause of the diabetes.

The most important and most serious of the complications of diabetes is coma. Three types have been recognized:[21] Kussmaul's "air hunger" type or dyspneic coma is the most frequent of the three. There are usually premonitory symptoms of lassitude, headache, epigastric pain and occasional vomiting. The patient becomes restless, excited, and his speech gets thick and finally incoherent. The senses grow duller and duller and he eventually lapses into deep coma. The sufferer becomes dyspneic, at first inspiration is affected, later expiration and then the respiration becomes stertorous. The respiration is usually regular and not increased, but is very noisy, being heard a considerable distance. The circumference of the chest greatly increases with each inspiratory effort, this demand for oxygen being the reason for the name "air hunger." The pulse becomes fast, small in volume, and of low tension. The breath has a fruity odor, the urine is loaded with acetone and all kinds of casts associated with albumin and there is general cyanosis. Death usually occurs within forty-eight to seventy-two hours.

The alcoholic form begins with headache and symptoms suggesting alcoholic intoxication, the speech is thick, the pulse rapid and the patient soon goes into coma, without any distressing respiratory symptoms.

Diabetic collapse which is sometimes noted begins suddenly. The patient complains of great weakness which is followed by drowsiness. The face becomes livid, the lips blue and the extremities cold; the pulse which is threadlike is around 130 to the minute, the respirations are shallow, slightly quickened, but not dyspneic. The drowsiness develops into sleep which deepens into coma in which the patient dies; there is no fruity odor to the breath, no acetone or diacetic acid in the urine. The collapse is believed to be due to heart failure induced by myocardial changes.

The cause of diabetic coma is attributed by Huchard, Kirstein, Corsuda and others to an acid poisoning. These acids though present in the normal blood are neutralized as has been discussed in the chapter on acidosis.

In this condition, however, the acids become so increased in amount that neutralization is impossible and the blood, being unable to carry out its functions, coma develops.

When actual symptoms of coma have set in, the treatment is almost hopeless, and the rule that prevention is better than cure is nowhere better illustrated than in this complication.

Intravenous injection of a liter of 4 per cent sodium bicarbonate solution is used after 200 to 400 c.c. blood have been removed; in addition subcutaneous infusion of 2 per cent sodium bicarbonate may be employed. Continuous proctoclysis of 2 per cent glucose solution in tap water should be kept up. Large quantities of milk should be given by mouth at least 500 to 1000 c.c. to which 100 grams of levulose are added, being used in 24 hours. Alkalies should be pushed until the urine is made alkaline. This, however, is hardly possible according to most observers. The temporary results are often encouraging, the respiration becomes more quiet and the patient may even regain consciousness. But in the cases which have been reported there was a recurrence of the coma in a few hours and death occurred in less than two days.

The treatment of diabetic collapse is the same as that carried out in shock (q. v.), which if persisted in usually prevents a fatal result.

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CHAPTER XXX

NEPHRITIS, ANURIA, AND UREMIC COMA FOLLOWING ANESTHESIA

By O. F. McKittrick, St. Louis, Mo.

Following an anesthetic, albumin and casts may be found in the urines of all classes of patients. From the statistics it appears that in more than one-third of the cases this complication occurs. If this condition was present before the operation, it is very apt to be made worse regardless of the anesthetic used. Ether and chloroform long ago were shown by Kemp,[1] Thompson,[2] Buxon and Levy,[3] and many others to be irritating to the kidneys. While chloroform is apparently not so apt to produce it, when such damage does occur it is more extensive, and the effects last much longer. If the kidneys are healthy, small amounts of neither drug is particularly irritating; but upon a diseased kidney the smallest amount will cause decided renal irritation, ether, of course, more often than chloroform, since less of the latter drug is required for an anesthesia. Gröndahl[4] studied 75 cases following ether narcosis and found in 36 per cent albumin and casts which frequently did not appear until the second day. In 20 per cent of these patients the nephritis appeared during the first day, while in 16 per cent it was seen on the day following. Depending upon the age of the patient, the duration of the operation and the amount of ether used, the albumin and casts disappeared within seven to ten days. In these cases the operations were particularly long and severe but the kidneys were apparently normal before the operations were started. A repeated narcosis was followed by the same urinary findings, but with diminishing severity.

From numerous observations of the urine it has been found that spinal and local anesthesias are also followed by changes in this excretion. These changes may appear in a few hours or be delayed several days, disappearing a few days later. No permanent or fatal results, however, have been recorded although I saw one some years ago. Tomaschewski claims that 60 per cent of spinal analgesias and 66 per cent of local anesthesias are followed by changes in the urine of greater or less importance. Csermak does not find so great a percentage of renal irritation, but Hartleib inclines to even a greater percentage than is claimed by Tomaschewski.[5]

The urinary findings are usually a trace of albumin, with hyaline, also finely and coarsely granular casts. In more severe cases in addition, epithelial, blood casts, and waxy casts appear with a considerable amount of blood in a highly concentrated urine. These showers of casts very probably result from the renal congestion due to the chilling of the relaxed surface of the body, from actual irritation of the kidneys by the anesthetic or from the effect of other poisonous substances upon the renal parenchyma.

Renal function is interfered with during the administration of ether, being increased up to the point at which the corneal reflex disappears, ceasing altogether during profound anesthesia.[6] Various degrees of suppression and concentration of the urine occur with an increase of the chlorides, urea, casts, and more or less of albumin, for a period of six to ten days, at the end of which time the urine returns to normal. The changes are not so marked following the administration of local anesthetics, albumin only being noted in a large percentage of the cases.

Rathery and Saison[7] have shown experimentally that ether inhalation in single or repeated administration is capable of producing lesions in the liver and kidneys of rabbits, the liver particularly being affected. The same is observed with chloroform, but the lesions are much greater in extent.

Thompson's[8] conclusions concerning the effects of ether upon renal function are as follows:

"1. During ether narcosis the volume of urine secreted is affected in two ways. In the majority of experiments there is a decrease, in a few an increase. The latter is probably an early or light effect, the former a pronounced effect.

"The depressing effect is, however, more marked than with chloroform, and complete arrest occurs more readily.

"2. The after-effect is less marked but similar to that of chloroform. The maximum outflow of urine occurs about three hours after removal of the anesthetic.

"3. The output of nitrogen with ether corresponds more closely with its influence on the outflow of urine than is the case with chloroform. In the late stages of the anesthesia, where the urine volume is decreased, the excretion of nitrogen is diminished almost exactly to the same degree as the urine volume.

"4. The effect of ether narcosis on the circulation of the kidney differs also from that of chloroform. With the former the urine, when diminished in volume is, as a rule, more concentrated (contains more nitrogen). The converse was the case with chloroform. The effect of ether is, therefore, primarily vascular.

"5. In ether narcosis, when the curves of urine outflows, kidney volume and blood pressure are compared, although there is not complete parallelism, there is, on the whole, a closer correspondence than is the case with chloroform. This statement does not apply to the arrest of urinary secretion, which occurs more readily, and with a relatively higher blood pressure in ether than in chloroform narcosis.

"6. The escape of leucocytes into the urine after free ether narcosis is more marked than with chloroform, probably indicating a higher degree of stasis in the glandular capillaries. Dilation of capillaries and escape of leucocytes have been noted by previous investigations, after ether inhalation, in the case of other vascular areas than renal.

"7. An increased excretion of chlorides is seen after ether inhalation, but is much less, and of shorter duration, than in the case of chloroform.

"8. Temporary albuminuria appears in dogs in a much larger proportion of experiments with ether than with chloroform.

"9. Reducing substances, not sugar, which were not present in the normal urine, appeared in a small number of the experiments after ether narcosis."

Grube[9] by extensive experimentation upon dogs has found that these reducing substances are caused by a disturbed heat regulation of the body. The temperature being reduced, the organism becomes chilled as above stated.

Primary acute nephritis is rare following anesthesia and the conditions which have been mentioned simply appear to be a renal irritation which is more or less transitory, or are the effects of a preexisting kidney lesion.

The treatment should begin upon the operating table, in that the least possible amount of the anesthetic be used and the patient not be unnecessarily exposed until the body becomes chilled. Immediately following the operation, plain tap water should be given per rectum by the drop method. A salt-free diet is allowed in the bad cases otherwise a regular routine postoperative diet, q. v., is prescribed. A pitcher of water is placed at the bedside and the patient is encouraged to drink all the water possible, a glassful being ordered every two hours in addition.

In spite of the best treatment the diminution of the quantity of urine secreted may become more marked, and can even develop into the stage of anuria. Anuria is, however, more apt to be noted soon after an operation, the result of some surgical accident like tying off of ureters or the removal of a solitary secreting kidney; in such instances, however, the patient will probably die within forty-eight hours. In cases where the ureters are involved, the individual will not succumb so soon, the prognosis being actually good if the condition is promptly relieved by operation.

Thomas[10] recently reported an anuria of five and one-half days' standing in a patient in whom nephrectomy had been done for pyonephrosis four years before. The remaining kidney function as determined by tests was found to be normal after recovery.

Basham[11] reported a case in which anuria first appeared on the twelfth postoperative day following nephrectomy for hypernephroma.

This condition most commonly follows operations upon the urinary tract. Traumatism of the tissues in a nephrectomy in whatever method is used to keep the patient in the usual kidney position, tends to cause this condition.

Permanent drainage of a distended bladder or surgical shock is followed at times by anuria, and at times an unrecognized acute nephritis has been the cause of this serious complication.

The symptoms which result from this condition during the early stages are not at all suspicious of any grave illness. The appetite is poor, the patient is usually restless and sleep is much impaired, but headache and vomiting may not be present. In a large proportion of the cases, some urine is passed at times; it is usually blood stained, of low specific gravity and contains very little urea or other excretory products. The symptoms are not at all relieved by such excretion and it does not in any way postpone the ultimate result, which is death, unless active medical, and in many instances surgical, measures are carried out to offset such an end. Though the mind remains clear, progressive muscular weakness is marked; the expression is anxious, the mouth and tongue become dry, the lips parched and the skin hot. The pupils are contracted and muscular twitchings are noted in many cases.

The patient becomes more and more drowsy, and while delirium may occur, convulsions are rare, while coma may be absent. The pulse rate is little affected, usually being slightly quickened while the temperature falls below the normal during the last stages. The patient is sometimes conscious up until the moment of death.

The treatment of this condition must necessarily be active and efficient. If after eight hours the patient has not voided, the forcing of water should be started as suggested in the treatment of nephritis, in addition to continuous subcutaneous injection of *distilled sterile water free from salt.* If patient has not voided after twenty-four hours, catheterize and immediately irrigate the bladder with a 2 per cent boric acid solution. If no urine is obtained or at most an insufficient amount, even after the above treatment has been carried out, the patient should at once be surrounded with hot-water bottles and the region of the kidneys dry cupped. An electric light bath is easily used and proves most efficient. It may become necessary to put the patient in a hot bath, and this is at once followed by ⅙ grain of pilocarpine hydrochlorate hypodermically. Such will sometimes start the urinary secretion. Thomas' case was efficiently treated by catheterizing the ureter and flushing the pelvis of the kidney with normal saline. The catheter was retained for three days and during this time frequent irrigations were carried out. Such treatment may be employed in addition to the methods of producing diaphoresis. If the patient's condition will permit, hydragogue catharsis also may be attempted. Any treatment whatsoever must be carried out with a knowledge of the condition of the heart, and stimulants given if necessary.

If the above measures fail, the kidney must be decapsulated as advised by Da Costa,[12] Edebohls,[13] Tyson,[14] and others. The technic of the operation is as follows: The kidney is exposed by the usual incision, the fatty capsule is removed from the true capsule, the dissection being continued around each kidney pole until the pelvis is reached. The kidney is now pulled out of the wound and the true capsule incised along the entire convex border and after separation from the kidney is cut away close to its junction with the pelvis. The kidney is then returned to its bed of fat and the wound closed. Drainage should not be employed unless there is severe edema according to Ertzbischoff.[15]

Uremic coma is to be expected in elderly patients in whom a chronic interstitial nephritis exists. It may also occur in younger individuals who give a history of severe attacks of diphtheria or scarlet fever in childhood with more or less kidney symptoms later on. Old prostatics are particularly prone to this malady.

However, according to Willson,[16] not all cases of chronic interstitial nephritis are subject to uremia, since neither sclerosis of the kidney nor, in fact, arteriosclerosis predisposes to uremia until hypertension of the vascular system is superadded. The two by no means go necessarily hand in hand. Many cases of high grade sclerosis present a comparatively normal blood pressure. Add arteriosclerosis and hypertension, with its consequent intracranial pressure to the local toxic irritation, and we have at once the ideal setting for the uremic picture.

The ultimate cause of the vascular hypertension of uremia has not yet been discovered. It would appear by no means impossible that the intracranial pressure is partly due to toxic or inflammatory exudate; that this causes hypertension within the cranium, and favors a similar hypertension throughout the general circulation, or vice versa; and that the symptom-complex of uremia is thus usually due to such a sequence of causes. Probably uremia can not occur in the presence of low intravascular and intracerebral tension.

Usually if the symptoms appear after a few days there is a premonition of the condition and the patient complains of sleeplessness followed by headache, dizziness, inability to see plainly, some epigastric pain and nausea. The blood pressure rises and the reflexes become exaggerated. Dyspnea and muscular twitching may develop with the increasing severity of the symptoms and finally delirium. The patient may now become comatose and remain in this state for days until death or convulsions may intervene. When these occur the eyes roll upward and to one side, the pupils dilate, and the patient stares. Then a jerking of the angles of the mouth, the head draws to one side, and the neck and face muscles become clonically convulsed, this spreading to the arms, and hands, then finally the musculature of the entire body is in irregular violent movements. The face becomes cyanotic and saliva issues from the mouth. The pulse gets rapid, weak and irregular, while Cheyne-Stokes' respiration is the rule. Incontinence of feces and urine may be present during the attack. After a few minutes the muscles become relaxed, the patient takes a deep breath, and after a short period in which he is dazed, will awaken wondering what has happened. If however, he was in a stupor before the convulsion, sleep, stupor or deep coma will follow.

The treatment is based upon the assumption that the poison which is at work is a nitrogenous product which fails to be properly excreted by the kidneys. In such cases a diet suitable to this particular condition has usually already been carried out. Active elimination through the kidneys, bowels, and skin is the best means we have for the combating of this condition. Water must be forced as described under anuria and at all times a liberal amount of alkali must be supplied, sodium bicarbonate and sodium citrate being most generally used under the skin or intravenous as a matter of course. (See Acidosis.)

While this treatment is being carried out the heart must be supported with some preparation of digitalis, which is a diuretic as well as a cardiac stimulant, the amount depending upon the symptoms.

Willson would employ lumbar puncture early in the course of uremia and repeatedly, if necessary, to accomplish the lowering of the systolic blood pressure. The good results obtained by him and others by this means very strikingly confirm Cathelin's[17] conclusions that there is a constant intercommunication between the blood circulation and the cerebrospinal fluid by means of lymph vessels.

The following post-hospital instructions are handed to every high blood pressure patient by Dr. Stuart McGuire:[18]

> Your wound has healed and needs no further attention. From a surgical standpoint you are well. From a medical standpoint you still need observation and treatment.
>
> Your watchword should be "Moderation." This is not because you are an invalid, but to avoid becoming one.
>
> Go slowly. Moderation will serve you in the wear and tear of life like oil to a good machine.
>
> Work easily; exercise lightly.
>
> Shortness of breath is a signal to slow down.
>
> Be temperate in all indulgences.
>
> Avoid excitement; cut out worry.
>
> Eat sparingly—finish a little hungry rather than replete. Better five small meals than three large ones. Take meat not more than once day, and sparingly then. No meat extracts. Limit salt. Highly seasoned foods are not desirable. Vegetables, fruits, bread, cereals, and milk should constitute your staple diet. Tea and coffee should be used moderately if at all. Your use of alcohol and tobacco should depend somewhat on your former habit. Decrease rather than increase. Drinking water should be neither limited nor forced.
>
> Keep the bowels open. Take Epsom or Carlsbad salts once or twice a week, if necessary, to make them a little free.
>
> Secure ample rest. Retire early and sleep late. Be a little lazy.
>
> Exercise regularly but not violently. Avoid straining at stool. Cold baths had better not be used. Warm or tepid water is preferable. Turkish baths should not be taken without the advice of your physician. He is fully acquainted with what has been done for you and what has been learned about you while you were at the hospital. You should consult him at reasonable intervals.
>
> Many men and women have done the best work of their lives, working under similar limitations.
>
> Please report your condition at the end of three months, by mail. If you are doing well the information will help us. If you are not doing well, we may be able to help you.

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CHAPTER XXXI

BACTERIEMIA (GENERAL SEPTIC INFECTION)

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The entry of pathogenic bacteria into the blood stream, followed by their growth and proliferation, is one of the most unfortunate incidences which may arise during a surgical convalescence. It is indeed a serious complication, one which sometimes causes a fatal termination after an otherwise favorable prognosis.

The term bacteriemia probably more clearly defines the true nature of the disease than the older appellations, septicemia or sepsis, which were used during the earliest periods to designate this condition.

It is common knowledge that bacteria are present in the mouth, nose, upper air passages, gastrointestinal tract in all animals, where they are constantly brought by the air, food and drink. They are also found on the skin, about the hair, and within the sweat and sebaceous glands. The urogenital tracts of men and animals also present their goodly share of these microorganisms. Despite the continued presence of the bacteria on the external and internal surfaces of the body invasion of the mucous and cutaneous covering of same is not to any marked degree accomplished, which results in the tissues and the blood, lymph, etc., being practically sterile.[1]

The lowering of the patient's resistance through operative procedure or by any other means invites the microorganisms to attack. Under these circumstances each of the anatomic regions named, becomes in addition to the operative wound, a possible portal of entry. For its defense, the body possesses a "protective mechanism" which consists in the main both of mechanical and biological factors.[2] Bacteria which are already present and have become active destructive agents through conditions mentioned above or through the occasional visit of microorganisms which are seen only under such circumstances, are met by the mechanical defense of the body first. These, however, are always active even under normal conditions, for example, the skin and mucous membranes, so long as they are intact, form the most efficient barriers the body presents. Mucous membranes are further aids in this respect in that they are, for the most part, situated in protected locations, and are in some instances reinforced with cilia, which materially assist in the mechanical defense.[3] The eye is protected from infection by the mechanical factors involved in winking, while the lacrimal secretions carry away material which may have entered. In spite of the close proximity of the air and other agents which carry bacteria, the conjunctival sac is sterile in 69 per cent of the cases.[4] The respiratory tract, though intimately associated with air laden with bacteria, is practically sterile below the glottis as shown by Jundell.[5] Meltzer believes this is explained in part by the action of the cilia, which throw back the bacteria that may have passed the glottis, while those which even the cilia fail to stop, are taken care of by the lymph nodes in the vicinity. He cites the observations of Loomis and of Pizzini who have found living tubercle bacilli in 40 per cent of peribronchial glands of patients possessed of nontuberculous lungs. The further attempt of the body to eliminate as many as possible of the invaders is seen in the action of the various sphincters, which prevent, to a certain degree, the crowding of the individual cavities with bacteria. The tears, saliva, and mucus, etc., remove the microorganisms which pass the sphincter sentinels or else kill many through bactericidal powers.[6] The number of saprophytic and pathogenic bacteria which are present in the upper alimentary canal are but small indeed, compared to the myriads which infest the large intestine. While it is true most of these microorganisms are harmless and even useful as an aid to digestion, many are pathogenic but their deleterious influences are outweighed by the action of the nonpathogenic. The intestinal mucous membrane plays a most important role in keeping these bacteria confined, yet according to Adami,[7] many are brought into the system proper through the agency of leucocytes which are contained in the lymphoid tissue of the intestinal tract. He has shown that not only the lymph nodes of normal animals constantly afford cultures of bacteria, but also properly prepared organs, such as the liver, kidney, etc., from these same animals will reveal pathogenic as well as nonpathogenic bacteria.[8] The net work of lymphatics and lymph nodes[9] throughout the body constitute another mechanical defence, too well known to require extended mention. The further action of the mechanical measures for defense is exemplified in the carrying out of the body, at least some of the infecting agents, by means of the secretions and excretions such as the bile, sweat, and urine.[10] Cohnheim[11] considers the secretions of the body the *chief* agent of defense in removing the bacteria from the body, to which Meltzer does not agree. However, he says that it is a general consensus of opinion that the toxins which always accompany these infections are excreted freely through these channels.

As to the biological defensive mechanism of the body, it has been shown repeatedly that if relatively virulent bacteria are introduced into the blood stream of a healthy animal within a comparatively short time, not only do they disappear from the blood, but also from the organs of the body as well.[12] However, a like number of the same microorganisms introduced into an animal with some necrotic lesion as shown by Cheesman and Meltzer[13] or even with chronic heart or kidney disease or other chronic ailment as shown by Flexner soon produce general bacteriemia and death.

The power of the body fluids and living cells to kill and dispose of bacteria has been known for some time.[14] The alexins or "defensive proteins" which have been shown to possess marked bactericidal powers, are the most important defensive ingredient of the body fluids. The leucocytes are the cells most prominent in bacterial destruction, though other cells of the mesodermal type are frequently actively engaged in this work. Through positive chemotaxis, the leucocytes are attracted to the invading bacteria, and overpowering them, finish the destruction through phagocytosis.

The normal invasion of the body by these various bacteria, Meltzer believes to be beneficial; he says it means an immunization only against larger numbers of these same bacteria during periods of lowered resistance. Probably he has sounded a great truth: viz., constant immunization makes general septic infection a rare occurrence. I feel that it applies especially well to postoperative cases.

The microorganisms which most often incite septicemia are the Staphylococcus aureus or Streptococcus pyogenes or both. Less frequently the Staphylococcus albus. In some cases the colon bacillus or pneumococcus are causative factors. General infection, however, has followed the invasion of the blood current by the gonococcus, Micrococcus tatragenus, tetanus bacillus or Bacillus pyocyaneus. The condition may occur as a result of a general infection from any of the acute infectious diseases which can complicate a surgical convalescence.

In all cases of suspected septicemia, blood should be taken for examination at the onset of the symptoms. If negative, it should be taken again in a few days. The early observers along this line, much more frequently secured positive blood cultures than the later observers. Welch[15] showed this was due to faulty technic among the former class of men. He has demonstrated that the Staphylococcus albus is frequently, if not constantly, present in the deeper layers of the skin, and that it can not be destroyed by the ordinary methods of cutaneous disinfection. It is, therefore, necessary to secure the blood under aseptic precautions from a vein, preferably the median basilic. The blood is aspirated by a sterile glass syringe, 5 to 10 c.c. blood being taken. Five c.c. is immediately placed into agar tubes, kept fluid at 42° C. at the bedside. Half the number (eight) after being thoroughly mixed with the blood are slanted and cooled. The other four are plated. Bouillon tubes (two) can also be inoculated with the same amount of blood. The material can now be incubated and in twenty-four hours or sooner, be examined.

The prognosis must always be guarded, but it should be hopeful,[16] since so much depends upon the virulence of the infective bacteria and the resistance of the patient. Many other factors also come into play which on the whole, make the prognosis most unfavorable, especially when the many possible complications are considered. The finding of the Staphylococcus albus in the blood is not particularly serious as Welch has pointed out and Bernheim,[17] Sittmann, Petruschky and others have reported cases which recovered when pure cultures of streptococci or staphylococci were found in the blood. Pneumococci are particularly virulent, but cases recovering from this infection have also been recorded.[18]

Symptoms.—The symptoms of this condition are varied but a typical case would run about so. Usually on the third postoperative day, the temperature rises to 102° or more. There are chilly sensations which may or may not be followed by chills. The patient may feel miserable. Sudden drafts or movements of the bed covers cause hot flushes. The patient is vexed, irritable, and in many instances seriously concerned, as though he scented danger of no little importance. There is likely to be headache, nausea, pain in the limbs, back, or a general "ache" throughout the body. Thirst is pronounced, the mouth becomes dry, the lips parched, and the tongue coated. Restlessness and sleeplessness are marked. One of the distinguishing features of this disease is the prostration. Its extent depends, of course, upon the virulence of the infecting microorganism. As the case progresses, the fever is soon followed by a cold sweat during which the temperature falls to subnormal at times. There are usually morning remissions and evening exacerbations. The prostration increases from day to day. Vomiting is the rule. The appetite is destroyed and there may be diarrhea. The urine is scanty or may be suppressed. The temperature fluctuates as a rule, often rising very high just before death. The pulse is fast, soft, small and easily compressible. In the aged, particularly, will be seen twitching of the muscles of the hands and feet (subsultus tendinum) or twitching of other muscles over the body, while in children, convulsions are the rule. Delirium alternates with stupor, which finally develops into coma, and usually closes the scene. Toward the end, the facies become hippocratic, presenting the characteristic hollow temples, pinched nose, sunken eyes, with the cold, clammy, leaden skin. In patients who live any length of time, there is great emaciation, loss of muscle tone, accompanied with pressure pains or toxic pains of neuritis or both together which cause the patient to cry out in agony.

The operative wound, if it be the seat of infection, will present the cardinal symptoms of inflammation.

But in many cases the focus of infection will not be in the operative wound. In such patients, the diagnosis may at first be overlooked. However, the history of the case and the physical examination in connection with the symptoms will decide the question even in the face of repeated negative blood cultures.

The spleen and liver become enlarged, petechiæ are found here and there over the body, and the abdominal muscles are board like, if there be accompanying peritonitis. In patients who are overwhelmed with the disease, a leucocyte count will reveal a leucopenia. This is always in my experience a grave sign. In cases of good resistance, however, there will be a marked leucocytosis.

Treatment.—The treatment first consists in draining and thoroughly cleaning up the focus of infection if this is possible. After thoroughly opening and draining the wound, continuous irrigation with Dakin's fluid or a hypertonic salt solution is instituted as soon as bleeding from the operative procedure has stopped. The work must be done under local anesthesia. The patient should be isolated to prevent infection spreading throughout the hospital and every care exerted to ward off contamination of the attendants. The temperature is controlled by cool sponging of the body and an ice cap to the head. For the restlessness and general discomfort, gentle massage and alcohol rubs are in order. The extremities must be kept warm, even if wrapping in cotton batting is necessary in addition to the hot-water bottles. The vomiting is controlled by the tube, one which can be left in continuously if nausea and vomiting are particularly bad. Let the patient assume any position which is comfortable. Keep up continuous hypodermoclysis, of 1,000 c.c. every 6 hours, using plain freshly distilled sterile water or salt solution. The lungs must be watched for edema in which event, the water is discontinued and atropine sulphate, $^1/_{150}$ grain, is given hypodermically every three hours until the danger signs disappear. Use 3 per cent glucose per rectum if the stomach can not tolerate food. If one should be so fortunate as to retain nourishment, frequent feedings of the most nourishing food should be given. Under any circumstances, give continuous proctoclysis, employing plain tap water in which has been placed 60 grains of sodium bicarbonate to the quart. The heart should be stimulated with some form of digitalis which is also a diuretic.

If the condition becomes chronic, the patient is given some good tonic and exposed as much as possible to sunlight and air. He should be treated in this respect the same as are cases of pneumonia, bronchitis, etc.

I have derived no benefit from vaccines or sera of any kind in acute cases though I have no desire to discourage their use in subacute or chronic conditions. One striking result was recently reported by Freemen in the treatment of chronic pyocyaneus infection.

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CHAPTER XXXII

POSTOPERATIVE TETANUS

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Tetanus occasionally follows operations even in this day of modern surgical asepsis and technic. It is a disease, infectious in nature, and one characterized by tonic and clonic convulsion, the muscles of the jaw being first affected. The process extends to the trunk and then to the extremities, finally involving every voluntary muscle in the body.

As a postoperative complication, Wilms[1] found five cases after herniotomy during the years from 1868 to 1879. In 1886, Olshausen[2] collected 49 cases following ovariotomy. Four years later Phillyss[3] added 64 more cases complicating this operation, which he had collected during the years preceding 1890. In 1891, Brunner[4] reported this condition appearing after a goiter operation. Five years later Santos-Fernandez[5] observed tetanus in one patient after enucleation of the eye. In 1897, Von Cackovic[6] collected 60 cases and Rose[7] during the same year collected 58 cases of tetanus after laparotomies. In 1901, Picherrin[8] collected 98 cases after operations, upon the female organs and seven years later, Zacharias[9] added 72 cases more. Peterson[10] in 1910, reported 49 cases which he had collected during the last twenty years.

Previous to the year 1890, the reported instances of tetanus after operations occurred more frequently after laparotomies; more than half of these being ovariotomies. This date, however, pretty nearly marks the beginning of the aseptic area and since that time, there has been a marked decrease in the instance of this complication. However, the ratio between the cases of tetanus in which the peritoneal cavity was opened and those in which this portion of the body was not involved, is about the same now as during the preantiseptic period according to Peterson.

The instance of the disease is more frequent in some localities than in others, but it may occur in patients situated on any part of the globe, occurring in every race, and especially in the negro. The age and the sex of the patient have no influence in the disease. According to Anders[11] tetanus in the United States is most prevalent in Pennsylvania, northern New York, New Jersey, Long Island, Virginia, Georgia, and southern Louisiana. It is also more frequently met in Indiana, Illinois, and southern California than in the rest of the states of the Union.

Tetanus itself has long been known. During the age of Hippocrates, the condition was recognized, and at that early date, the disease was considered to have a predilection for the nervous system; however, no progress was made in the study of this condition until the latter part of the nineteenth century when Sternberg[12] showed that he could produce the symptoms of the disease in animals by injecting dirty water. In 1884[13] these same symptoms were caused in animals by injecting pus from a patient suffering from tetanus.

Nicolaier[14] during the same year described the tetanus bacillus, but it was not until 5 years later that a pure culture of this microorganism was obtained by Kitasato.[15]

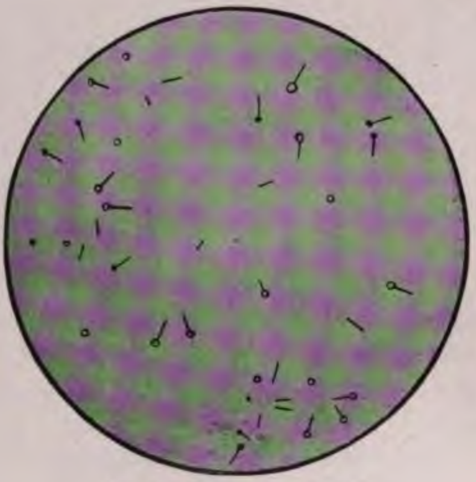

Fig. 37.—The tetanus bacillus.

The tetanus bacillus[16] is long, slender, and mobile, often appearing in pairs; a spore develops at one end which gives it a club-shaped appearance (Fig. 37). It stains readily with ordinary stains, grows at room temperature in the regular culture media, is strictly anaerobic, and develops rapidly in an atmosphere of hydrogen. The bacillus is easily killed with ordinary antiseptics, but the spores, unlike the bacillus, are very resistant to chemical disinfectants, to heat, or to drying. According to most observers, exposure to a temperature of 100° C. for 5 minutes will kill the spores; or a 1:1000 bichloride solution will destroy the spores in 10 minutes; a 1 per cent silver nitrate solution in 1 minute, or 1:1000 solution of the same in 5 minutes.

The bacilli are very widely distributed, their normal habitat being in manure, garden soil, dust of the streets, walls, etc., but especially in the intestinal tract of animals. As found here, their virulence is most marked, which, however, diminishes in proportion to the length of time they are outside the intestines.[17]

The sources of infection in postoperative cases according to Speed[18] are: the operator's hands, the instruments, dressings, air, ligatures, or the patient himself. Of these avenues of infection, all are so evident that discussion is probably unwarranted, save of the last two, which have until lately, been obscure points.

From the above, it is not surprising that catgut, which is made from the intestines of animals, should be a source of tetanus infection. There is good proof on both sides of this question, but with the development of newer and better methods for sterilization, smaller size catgut is being used, and the danger from this source is more and more becoming lessened. Richardson[19] collected 21 cases of postoperative tetanus in which catgut was considered at fault. It was thought that many of these cases came from localities in England where tetanic sheep were known to be and it was naturally supposed that the sheep gut caused the infection. Later investigation proved that the catgut had all come from Germany and that the catgut which was examined from 14 of the patients, contained no bacilli. In 19 of the 21 cases collected by Richardson, the operation was a laparotomy and the bowel was handled more than usual or else sutured. Richardson mentions in this same article the experience of one operator who performed five abdominal operations one morning and used in each case the same preparation of catgut. Two patients developed tetanus, but the other three escaped.

On the other hand in support of the view that catgut is the source of infection, Peterson, after extensive experimentation with catgut, in order to prevent just such a calamity after a postoperative case of his own stated: "I fear that many operators who report cases of tetanus after clean operations have fallen into the same error as I in their attempts to absolve the catgut from any part in the causation of the disease. At first sight it seems reasonable to say it could not have been the catgut, because the same material was employed in other cases with no bad results. Kuhn, however, has shown the fallacy of such an argument. He asserts that catgut is made from the intestines of sheep which exist under different conditions and vary greatly in health. Every catgut thread contains fibers from four or five different sheep. Just one of these fibers may contain the tetanus bacillus, while the others may be free from this particular germ. He further states that the sanitary conditions of the slaughter houses and factories from which the catgut comes are notoriously bad, exposing the raw material to all kinds of contamination.''

In June, 1909, Matas[20] reported two cases of postoperative tetanus following the ingestion of uncooked vegetables. He directed attention to the danger of this infection even after clean operations on patients in whom the wound may become contaminated with fecal material. This condition may accompany operations in the region of the genitourinary organs of either sex, the sacrococcygeal or anorectal regions, operations involving the inner surfaces of the thigh, legs or any other region of the body which may come in contact with fecal discharge.

Matas' ideas concerning the origin of tetanus infection have been supported by many observers. Among those may be mentioned Speed, who has gone a step further, however, in that he has promulgated a theory based on his own observations and on the experimental and biological work which has been done on this subject; viz., that the few instances of postoperative tetanus which develop in spite of every preventive means are due to tetanus carriers. He thinks it very probable that some human beings carry and excrete the organism for long periods of time. Considering such individuals as surgical patients, he says, ''Their greatest danger is to themselves because after operative procedures which permit fecal contamination of the wound, tetanus may be inaugurated. This is particularly true of abdominal operations where the gut is bruised or roughly handled and opportunity for tetanus development ensues in accordance with the pathologic requirements.''

Formerly it was taught that tetanus was not an infection in the sense that the bacilli entered the blood stream or any organ. The toxins produced by the growth and proliferation of the organisms which were present within the wound were alone considered the agents which produced the symptoms. During recent years, however, the bacilli have been found in lymph glands,[21] in the blood stream,[22] in muscles, in the spinal canal, in nerves and even the brain[23] itself, of patients infected with tetanus. Positive cultures of the tetanus bacillus have been grown on several occasions from the blood of patients suffering from this disease. It mattered little whether the blood was taken at the site of the infection or from some other region of the body. Schnitzler[24] obtained the bacilli from a lymph gland as well as from the blood stream and succeeded in getting positive results by animal inoculation from both these sources. According to Meyer and Ransom[25] the toxin produced by the tetanus bacilli reaches the spinal cord through the agency of the motor nerves only, but Jacobson and Pease[26] state that other nerves are involved as well, since the toxin is present in the blood and lymph as well as in the axis cylinders of the motor nerves which are especially affected because in the lymph spaces their bared endings are particularly exposed to the poison. Once in the cord the motor cells are attacked, pathologic changes being produced as noted in other infections and the toxin ascends the motor tracts to the medullary centers where further destruction of the nervous tissue is consummated. Meyer and Ransom further state that the basis of this disease is a spreading irritation of the motor neurones of the cord, which produce the tonic contractions of the muscles, and an extreme reflex excitability due to poisoning of the sensory neurones which causes the clonic convulsive seizures.

The symptoms of this dreaded disease appear within ten days in four-fifths of the postoperative cases reported by Peterson as collected since 1890. In the remaining one-fifth, the initial symptoms did not appear until the eleventh to the twenty-second day. The usual incubation period of the tetanus bacillus is from 3 to 5 days. It is considered that the shorter the incubation period the more intense will be the symptoms and the quicker will be the fatal termination of the disease.

Elvler,[27] who had contracted the disease while operating on an infected patient, lived to tell of the symptoms which he experienced. He stated that the earliest manifestations of it were very short and transient in nature, and were attributed to the healing wound. This felt hot and uncomfortable and darting pains were noted before any swelling or redness occurred. Among other important symptoms he mentioned headache, sleeplessness, restlessness, difficult respiration, dizziness, chilly sensations, with frequent and difficult urination. Later the symptoms assumed the form which have been considered characteristic of the malady.

Stiffness of the jaw is most commonly first to be noted by the patient. This is very soon followed by stiffness of the neck. As the disease progresses, other muscles become involved until finally every voluntary muscle in the body is stimulated to tonic contracture. Any sensory stimulation such as drafts, sounds, lights, even the touching of the bed or the contact of the bed covers will cause clonic seizures in addition to the tonic convulsions from which the patient is already suffering. There is constipation, and in some instances retention of urine due to sphincter spasm. Irritation of feces or urine or attempts at deglutition will bring on sudden fearful clonic convulsions in which he may injure himself. Teeth are frequently broken and muscles ruptured during the hardest spells. Naturally such a disease will cause the patient to assume all sorts of hideous postures (Fig. 38) which are temporarily exaggerated during the clonic convulsions, but probably the worst feature of the whole picture is the clearness of mind which the patients possess throughout the entire period of suffering, even until the end. Death occurs usually within four days in patients whose symptoms appeared within ten days of the operation, but one case reported by Peterson lived twenty-five days. The mortality as shown by a study of his cases is 85 per cent.

Treatment.—The treatment of this disease first seriously concerns itself with preventive measures undertaken to offset such unfortunate occurrences. Matas recommends that patients about to undergo operations which involve areas subject to fecal contamination should abstain from such foods as vegetables or fruits which have not been thoroughly cooked. In addition, free catharsis three or four days before should be instituted. In cases where such preparation can not be made or in patients living in localities where the disease is especially prevalent, Matas advises a prophylactic dose of antitoxin.

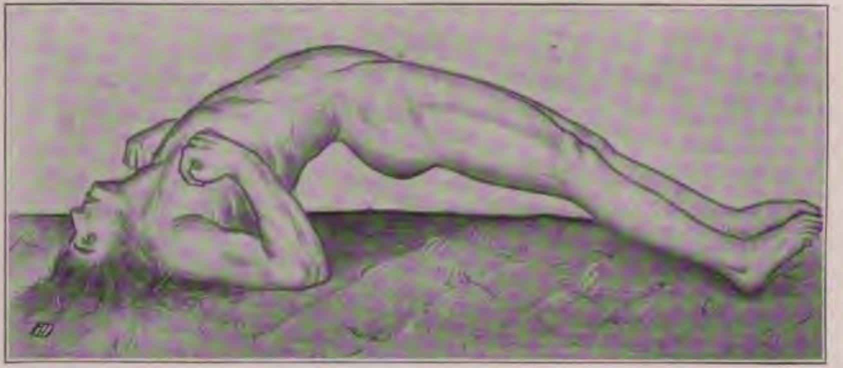

Fig. 38 —Opisthotonus.

If, in spite of such treatment the symptoms appear, or even if there is a suspicion of such a condition, the patient should be moved into a darkened room which is well ventilated, free from the ordinary noises of an institution, and every effort should be put forth to exclude possible sources of peripheral irritation. At once, administer 10 to 30 c.c. of antitoxin subcutaneously near the draining wound if one is present; but if the fluid serum be not available, 1 gram of the powder dissolved in each 10 c.c. sterile water may be used instead. Such a dose should be given every 6 or 8 hours until there is improvement. Then half of this amount is administered and as the symptoms abate the amount is still further cut down and the interval of administration increased.

Give plenty of soft solid or liquid foods with liberal amounts of alkalies. If deglutition causes severe pain or brings on convulsions, feed the patient per rectum. It may be possible to partially anesthetize the pharynx with cocaine. After this measure, food can be introduced through a stomach or nasal tube.

If the wound has healed, particularly one about the extremities, it should be opened widely and large cigarette or rubber drains placed in every angle. The wound is then washed out with 1:1000 silver nitrate solution, or tincture of iodine which has been diluted to one-third its strength with alcohol. After a few hours when the bleeding stops, remove the dressing and irrigate continuously with Dakin's fluid, leaving only a few layers of gauze over the wound to assist in caring for the drainage. The affected portion is then placed under a cradle which supports several electric light bulbs or else exposed directly to the sun's rays.

Careful attention should be given the bowels, as detailed under the headings "cathartics" and "enemas." Water freely given by mouth, by rectum or under the skin will greatly aid urination.

Sleep and rest is secured by giving per rectum chloral hydrate or chloretone in warm olive oil; 30 grains of the former or 60 grains of the latter, may be given at one dose. It may be necessary to employ some form of opium to get the desired rest and sleep.

In *violent* cases of tetanus, 40 to 50 c.c. of antitoxin is given as above. Walther[28] has recently noted that doses as large as 760 c.c. have been administered within twelve hours. He recommends intraspinous injection which he claims gives better and quicker results and much smaller amounts of the serum are needed. Following the injection, he places the patient with the head down for a short period of time. Magnesium sulphate may be employed for the constant muscular contractions which will soon exhaust the patient unless relieved. Burge[29] has recently reviewed the work on this chemical which has been shown to be an efficient agent for stopping pain and producing sleep. Kocher[30] has reported good results from its use. He employs 10 c.c. of a 15 per cent solution of the chemically pure salt. If the severity of the case warrants it, 2 to 5 c.c. of a 25 per cent solution are used, repeated two to four times during the twenty-four hours. It is usually given subcutaneously, but if quick results are imperative, this dose may be given intravenously or intraspinously. Calcium chloride, an antagonist of magnesium may be administered to patients receiving this treatment, which endangers the respiratory center at times. Magnesium sulphate should be given only to the point of controlling the convulsions, though some stiffness of the muscles will still be present. Kocher says that so long as this rule is followed, the respiratory center will not be paralyzed. The drug should not be given in quantities in excess of 1½ grains of magnesium sulphate to 2⅕ pounds of body weight during the twenty-four hours. Children, especially, do not take kindly to this treatment, and particular care must be observed in its use among them.

Patients in whom satisfactory results are not obtained with the antitoxin, chloral, chloretone and magnesium sulphate, should according to Hercher[31] be given 15 c.c. of ether in 750 c.c. normal salt. The dose can be repeated as often as indications warrant.

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CHAPTER XXXIII

GAS BACILLUS INFECTION

By O. F. McKittrick, St. Louis, Mo.

Since the days of Lister, gas bacillus infection has so decreased in frequency as to be considered now as one of the rare complications following surgical procedures. The condition was described as early as 1853, by Maisonneuve,[1] who gave it the name of "gangrene foudroyante." Pirogoff[2] in writing on this same subject in 1864, considered the affliction an "acute gangrenous edema." Later on it was revealed that the disease could be transmitted, but it was not until 1891 that the cause of this malady was made known through the discovery of the Bacillus aerogenes capsulatus by Welch.[3] Two years later, Fraenkel[4] described the organism which produced "gas phlegmon" which proved to be the same as the one described by Welch. Further investigation by others demonstrated this microorganism in wounds characterized by the formation of gas, and the identity of the bacterium became established. Nothing of material importance has been added to the work of Welch on this subject, except Dunham's discovery in 1897, that this microorganism produces spores.

Bacillus aerogenes capsulatus (gas bacillus) is rather large, short, thick and sometimes curved with rounded ends. It grows in the ordinary media at room or body temperature only under strict anaerobic conditions. In this respect, it resembles the tetanus bacillus. It is a spore-forming, nonmobile organism which takes the ordinary aniline dye stains and is Gram-positive. It is often encapsulated and sometimes forms chains. It is readily killed by exposure to 58° C. temperature for ten minutes. The growth of the bacillus brings about a splitting of the protein or sugar which results in a gas being formed consisting mostly of hydrogen; carbon dioxide and nitrogen are also present. It burns with a pale blue flame. The natural habitats of the organism are the soil, and the intestinal tract of animals. It has been repeatedly demonstrated in the feces of man.

Infection with this microorganism in postoperative cases is rare, yet it occurs often enough to demand attention. It most frequently follows emergency operations on patients with crushing injuries, particularly of the lower extremities. Coal miners, trainmen, soldiers and laborers especially exposed to the soil are more apt to be the victims of this malady than the regular hospital operative patient. Swan,[5] Bolby and Rowlands[6] and many others have recently reported the condition following all sorts of injuries and operations necessitated by the same, in the great World War. In every case, however, the tissues were either badly bruised or else contaminated with dirt, or both. Tissues whose resistance has been lowered by contusion or deprived of the normal blood supply have been shown by all investigators on the subject to be especially good media for the growth and development of the Bacillus aerogenes capsulatus. Operations about the groins, inner portions of the thighs, upon the male or female urogenital organs, in the anosacral region, or in any portion of the body where fecal contamination is possible, may result in this infection. It has followed appendectomy and other operations upon the gastrointestinal tract. Curettage following abortions has also been complicated by this disease. Of the cases reported by Blake and Lahey[7] three were crushing injuries to the extremities, four were compound fractures, and one a laceration of the scalp. In each instance the wounds were contaminated with soil. One followed opening of a deep gluteal abscess and one occurred after amputation of the leg in a diabetic. In 1911, Hewitt[8] reported ten more cases. These were the result either of wounds becoming contaminated with dirt and necessitating operation or the infection developed in several traumatized wounds which later required operation.

Gilpatrick[9] reported this complication after a hemorrhoid operation with opening of an ischiorectal abscess. Hewitt says the rarity of this infection in such cases is due to leaving the wound wide open, the bacillus being unable to grow in the presence of oxygen which the air contains. He further states that such infections do not develop in very many cases of soil contaminated wounds, hence it would seem that pulpification of tissue and injured blood supply favor bacillus aerogenes infection owing to weak or absent resistance. The presence of this microorganism on amputation stumps without infection in other reported cases, he says, bears out his conclusions. Recently, Dudgeon[10] stated that gas gangrene is produced by this infection alone in "especially abnormal tissue." Otherwise ordinary suppuration will result. He obtained cultures of the bacillus from cases of peritonitis, puerperal fever, bone abscess and cystitis, in which no evidence of this condition was apparent.

The symptoms are those of a severe toxemia. In the milder cases, there is a slight rise of temperature and pulse, but the patient appears much more ill than the physical examination denotes. The wound presents a dark, thickish, bloody discharge in which a few bubbles of gas may be present. The wound is not red, but appears to be covered with a decomposing black blood clot from which gas bubbles may be pressed. There is a vile, penetrating, pungent odor as of stagnant blood enclosed in a cavity, which very soon will permeate a whole hospital ward. The immediately surrounding skin is brown in color, and looks ecchymotic except for the fact that there is no mottling.

In *more severe* types of the infection, the patient not only looks sick, but on examination, will instantly convince one that he is seriously ill. The temperature is high (104° F.) with a rapid pulse and respiration and before the dressings are removed from the wound, the odor will many times confirm suspicions as to the real nature of the trouble. The incubation period of the bacteria being only twenty-four hours, the disease progresses rapidly. Within a few hours, the wound will look as though a hot iron has been seared over its surface, being dry and black, or it may present a grayish slough.[11] At the end of twenty-four hours, swelling is very marked, the skin is drawn tense and becomes shiny. Palpation elicits crepitus due to the gas within the tissues. At the end of forty-eight hours, if the patient lives this long, the face assumes a "greenish pallor," the expression is anxious but he rarely complains of any pain. The nature of the infection produces necrosis and with the pressure of the gas, nerve conductivity is, no doubt, seriously interfered with, this explaining the absence of pain.[6] The temperature and pulse remain high until the end. This is probably due to the additional infection with other microorganisms.

The gas dissects along the fascial planes and follows the lines of least resistance. The tendons, ligaments and fascia resist the infection, but the injured muscle certainly furnishes good media for the rapid growth of the bacillus, hence pulpifies early. The lymph glands are rarely affected, probably due to the rapidity of the disease.

Nausea and vomiting occur late, as does the delirium which is an indication of a general infection. Recovery is not the rule after the third day.

The mortality has gone as high as 90 per cent among soldiers in some past wars. Recently, Gamble[12] reported 45.5 per cent mortality in a small number of patients. Bell insists that it should be *nil* if treatment is instituted early enough.

The treatment for this condition starts at the time the patient is received if the nature of the case causes suspicion of such a complication developing. The wound must be thoroughly cleansed of all foreign particles. In these cases of crushing injuries or fractures contaminated by dirt or grease to prevent this infection wide and deep incisions should extend through the muscles and down to the bone; large rubber or cigarette drains should be placed in every one of them; each wound should be continuously irrigated with Dakin's fluid, or a hypertonic sodium chloride solution. A cradle can be placed over the parts and the wound exposed to the rays of electric light bulbs. At the first sign of the disease, at once start a stream of oxygen into every recess of the wound by means of catheters, in addition to the treatment already outlined. If in spite of the oxygen and the continuous irrigation, the disease progresses, there is nothing left, according to most writers, but to amputate the extremity high up (for it will most likely be in an extremity), and keep the stump open, maintaining the stream of oxygen.

Amputation is still a debatable procedure in this disease as it seems to me. At the St. Louis City Hospital in 1910-1912 several patients were lost after amputation, then a number of successes were scored under rather similar circumstances where no amputation was done.

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CHAPTER XXXIV

POSTOPERATIVE PNEUMONIA

By O. F. McKittrick, St. Louis, Mo.

The occurrence of pneumonia in postoperative patients has always been considered a serious complication, probably, one which the surgeon considers first, and measures taken to prevent this one accident alone may be seen during the course of operation in any hospital on the globe.

Experience has long ago taught that a disease, so destructive to life, and yet one so easily preventable, commands serious attention.

In spite of the modern methods of operating and the infinite care exhibited in surgical patients, in order to prevent the disease, there are still evidences that more can be done to further decrease its instance. The efforts already put forth have cut the number of cases reported to a small item compared to the many thousands of individuals who are yearly subjected to the knife. Statistics are of little value, but may give some idea of the frequency with which the condition occurs in the hands of the very best surgeons.

Beckman[1] found pneumonia 27 times in reviewing the complications which occurred in 6,825 surgical operations at the Mayo Clinic during the year 1913. Risley,[2] in 1910, reported 15 cases of pneumonia occurring after 1000 consecutive laparotomies at the Massachusetts General Hospital, and 5 cases, after 920 other operations, not laparotomies, on various portions of the body. Quite recently, Whipple[3] collected 42 cases out of 1002 operations performed at the Presbyterian Hospital. Booth[4] found 23 cases out of 2612 performed at the Roosevelt Hospital; Bancroft[5] discovered 15 cases out of 1413 operations performed at the New York City Hospital; and Derby[6] collected 11 cases out of 3120 operations performed at the St. Luke's Hospital, all in New York City. The percentage is therefore very small, ranging from .04 per cent reported by Beckman, to 2.2 per cent reported by Whipple.

The figures are indeed low, and probably do not present the true incidence of the condition, since it is to be remembered that the operations were performed under ideal conditions.

Whipple after making careful clinical, as well as bacteriologic observations, concluded that the cases of pneumonia should be divided into three groups: Group I contains those patients who were in a good physical condition before the operation, and in whom the disease developed from the first to the fourth postoperative day. He found that 79 per cent of the cases fell into this group.

Group II is made up of patients who came to operation with pneumococcus infection in other parts of the body, excluding the lungs. This group claimed 7 per cent of his cases.

Group III included those patients who developed pneumonia (a) as a terminal complication; (b) in the presence of other severe infections, (c) or in the feebler senile patients in whom this disease appeared in the late days of the surgical convalescence.

It has been generally conceded that bronchopneumonia is most often the type which is seen in these cases. Beckman, however, showed that 15 of his cases were lobar pneumonia. Derby stated 8 of his cases presented signs of lobar pneumonia. This was also true in Booth's cases. Whipple was inclined to believe that a majority of his cases were lobar pneumonia.

The signs and symptoms in these cases were atypical of frank lobar pneumonia, and there was a tendency for the disease to end by lysis. The condition has been seriously considered by Bancroft to be due to multiple infarcts. Beckman also concedes that he "believes septic emboli cause many of these conditions."

Whipple explains that the diagnosis of *lobar* pneumonia was made by the x-ray. A systematic radiographic examination of every patient showing a rise in temperature, with more or less cough with suspicious blood findings, revealed many cases of this disease which would ordinarily have been overlooked. By this means, beginning consolidations of the lungs were noted even before the physical signs appeared.

In other cases the x-ray confirmed definite physical findings, after the temperature had dropped to normal.

The atypical symptoms and absence of complications are also explained by Whipple. He states that bacteriologic examinations of the sputum, by culture and mouse inoculations, revealed the pneumococcus in 77 per cent of the cases. The type of organism, however, was of the least virulent group, as classified by Dochez and Avery of the Rockefeller Institute.

This type of the pneumococcus is found in the throats of normal individuals who have not been in contact with pneumonia patients and who have not undergone any operation.

The malady occurred in 30 males, and 12 females of the cases reported by Whipple. Thirty-seven of this number were adults. In the collection of the other cases, where the ratio of sex is revealed, the percentage of male to female compares favorably with Whipple's figures.

The age embraces patients from two to seventy years old.

Operations on the appendix, stomach, and gall bladder were about equally divided as to the frequency of occurrence. Acute appendicitis, with or without pus, was more frequently followed by pneumonia than any other operation. It is generally conceded that pus cases are more likely to develop this disease than clean cases.

Pelvic operations do not particularly predispose to pneumonia. Probably, this is due to the Trendelenburg position on the operating table, which allows the air passages to drain thoroughly during the operation. Therefore, the lessened number of cases of postoperative pneumonia appearing in women may be attributed to this fact.

The winter season has particularly been found to be conducive to this infection, although Bancroft stated that the time of year had no effect on the frequency of occurrence in his cases.

The predisposing factors are varied. Sajous[7] notes that it is favored by a protracted anesthesia, preexisting coryza, bronchitis or some chronic pulmonary congestion, general weakness, and the inhalation of irritating substances. To these may be added, old age, chronic infections in the mouth or upper respiratory passages, pus cases, and high abdominal operations.

Ether in itself, as a predisposing factor, has been studied by Chapman.[8] He finds that by injecting this substance into rabbits' lungs, rales appear at once, the temperature rises, the respiration increases, the nostrils dilate, and the animal presents the characteristic appearance of air hunger. After a few hours, it dies. Examination of the lungs reveals at the site of injection, "hemorrhagic tissue, which is solid, of a dark red color, and sinks in water. The stained sections show absolute dissemination of the normal lung tissue. The whole inflammatory area presents a mass of red blood corpuscles, white blood cells and cells from the alveolar walls. Farther out, the lung tissue can be recognized. The lung also shows the alveoli filled with hemorrhagic exudate, and broken down cells of the lung tissue.

"If the rabbit is etherized in the usual way, and the narcosis is continued about 30 minutes until rales appear, the bronchial tissues become congested and the alveoli filled with corpuscles. These on macroscopic examination appear as small hemorrhagic areas. Repeated etherizations will decrease the time of the appearance of the rales, and increase the amount of hemorrhage into the lung tissue. Crowding the ether will also tend to hasten the condition."

It has been shown that the lungs of healthy animals do not contain bacteria. After etherization, however, any number of microorganisms may be found. So also a culture of pneumococci injected into the lungs of healthy animals will not produce pneumonia, though death may be caused by the resulting abscesses. On the other hand, if an animal is permitted to inhale pneumococci, following etherization, all the features seen after prolonged ether narcosis are noted, but in addition, are very much intensified. Chapman, after his experiments, then, concluded that ether, in producing small hemorrhages in the lungs due to its irritant action, caused a most suitable soil for the growth and development of bacteria, which normally the lung tissue would not tolerate. Unfortunately, the patient is further exposed to pneumonia from mucus or infectious particles from vomitus sucked into the air passages incident to anesthesia.

Another predisposing factor which must be considered is the exposure of the body surface, which necessarily occurs during the preparation of the patient for an operation. Cold, cleaning solutions, wet clothes coming in contact with the patient's skin and particularly a perspiring patient exposed to a cold corridor immediately after his stay in a hot operating room, are important predisposing factors.

In this connection, the practice of nearly every hospital, of absolutely ignoring the former habits of surgical patients, is undoubtedly followed, at times, by serious consequences. Regardless of how the patient is accustomed to clothing himself for bed, he is usually given a tub bath, a nightgown of light weight, opening in the back, is placed on him, and he is put with insufficient covering, into a strange and sometimes uncomfortable bed. He stays here just long enough to get a general congestion of the respiratory passages, probably an acute cold which has not sufficiently exhibited itself to prevent him from being sent to the operating table. He is here exposed to a cold metal support, which is inadequately covered to prevent its deleterious effect by coming in contact with his bare back.

The microorganisms found associated with this disease, have common morphologic and cultural features, but biologically are divided into a number of groups, each of which causes specific reaction on the part of the tissues. Those cases which present the bronchopneumonic type, in addition to the pneumococcus, also include various types of streptococci as well as other microorganisms, such as the micrococcus catarrhalis, the influenza bacillus and various other rarer bacteria.

The prognosis is almost uniformly good in pneumonia, after clean surgical cases and in patients in good condition before the operation. In the very young or the aged it is universally bad. Beckman reported recoveries in all his cases. In the cases presented by Risley, however, the mortality varied from 25 per cent in clean laparotomies to 70 per cent where the abdomen was opened in the presence of pus.

The mortality from pneumonia in operations other than laparotomies, as reported by this observer, was 40 per cent. In Bancroft's cases, which included laparotomies, as well as other operations, 46.6 per cent died. In Booth's cases 30 per cent succumbed. Those cases which recovered, showed no further symptoms of the disease. It has been a notable fact, that in the clean cases, the disease is much milder in nature, and of shorter duration, than in septic cases.

Pneumonia usually does not occur before the third or fourth day after operation. It may, however, occur earlier. In one of Risley's cases which presented rales before the operation, pneumonia developed within twelve hours after etherization. Eleven of Booth's cases appeared within twenty-four hours, and three of Bancroft's cases also had definite signs by this time.

Symptoms.—The symptoms are varied. The condition does not present a definite onset, and the usual course of a lobar pneumonia is not followed out, nor does the disease take the course which is usually pursued by bronchopneumonia. As a rule, the onset is initiated by some rise in temperature, slight quickening of the pulse and respirations. There may or may not be cough, but later this symptom appears, the severity depending upon the extent of the pulmonary involvement. The temperature, after remaining elevated from twelve hours to about one week, falls by lysis. In many cases the signs may not be discovered until the symptoms have subsided. This fact has been definitely shown to be true by Whipple, and others. Cases presenting the faintest symptoms are now radiographed, in order to begin treatment early.

The symptoms and signs of pneumonia, in general, are so well known, that to rehearse them here would be superfluous. The recital of the following case history, in this connection, however, may be of value, as well as interesting:

J. J., male, forty-five, operated for appendix abscess. This was drained, patient put to bed, and peritonitis treatment instituted. Postoperative course uneventful; temperature, pulse, and respiration normal for seven days. On the eleventh postoperative day, temperature went to 99.5°, pulse 80, and the respirations to 20. No serious trouble was suspected. The following day, the temperature was 100.5.°, pulse 83, respiration 24. The man felt well, complained of no pain, and general condition was apparently normal, with indefinite lung findings. One day later, patient noted a very sharp pain on breathing and complained of nausea. The temperature was now 101.8°, pulse 94, respiration 28. Definite signs of pneumonia, lobar in type, in the right lower lung were discerned. Dry cupping (Fig. 41) was instantly instituted, and from the first application, the temperature dropped to normal. The pulse gradually fell, and after two days was

72. The respirations fell to 18 after three days. The patient had no more pain or discomfort of any kind. The cupping was kept up twice daily for three days, at the end of which time, all rales and other lung signs had disappeared.

Treatment.—The treatment first consists in systematic preventive measures being executed in patients who enter hospitals for operation. The tub bath of tepid water is desirable and the replacement of all underwear with the nightgown, is to be hailed with delight, but I would certainly advise gowns which are opened in front, and some, at least, made of heavier material, to accommodate those patients not used to removing the underwear on retiring. No patient should be allowed to become chilled. The teeth should be scrubbed at least three times a day, with a toothbrush and this followed by a thorough washing with Dobell's solution, or some other alkaline mouth wash. The lungs should be carefully examined and patients with coryza or bronchitis should not be operated until the condition has subsided. In such cases or in other lung complications, the operation may be done under local anesthesia. If ether must be used, give as little as possible, and at the same time overlook no opportunity to drain the air passages of the excessive secretions excited by the anesthetic even if the Trendelenburg position may be used to accomplish this end.

At the close of the operation the patient is wrapped in blankets, the head, but not the nose or mouth, protected, and is sent to a bed, previously warmed with hot-water bottles. It is a notable fact, that pneumonia occurs more frequently in those patients who are wheeled through long corridors to their rooms. The recovery room in hospitals through elimination of this exposure has materially cut down the incidence of the disease.

As soon as the operation is ended the wet gown is removed, the body is rapidly dried and clothed in a dry warm gown. Fresh air, a room temperature of 68°, and comfortable body warmth is now maintained.

The patient is placed in a position which will allow free drainage of the nose and mouth, and upon awakening, is permitted to assume any position most comfortable to him. Aged patients, particularly, are put into a wheel chair a day or so after operation, and all patients are encouraged to move around in bed. As soon as possible they are allowed to get up.

Following operations in the upper abdomen, especially gall bladder operations, as high a position in bed as can be maintained is encouraged. In these cases, particularly, the lungs are likely to become inflamed due to the handling of the high peritoneum and diaphragm. In addition to the regular orders for all operative patients to take frequent deep breaths, these patients are assisted by an apparatus which was devised by Bartlett and myself (Fig. 280, page 741). It consists of an ordinary mercury blood pressure apparatus, which is connected by a series of rubber tubes, to a rubber bag. The patient, on blowing at the mouthpiece, which is connected to the rubber tubing, is enabled to register his pulmonary strength on the scale of the blood pressure machine. In attempting to increase his capacity, deeper and deeper breaths will be taken, until finally all pain will disappear from the affected side. In many instances patients are not able to raise the mercury column higher than 6 mm. when they begin, but after two days' effort they are back to normal again.

I have never had a postoperative pneumonia occurring after this routine has been carried out. If pneumonia occurs, the patient is removed to a quiet room with a southern exposure. Sunlight and air are freely admitted into the room, which is kept at 65° temperature. Absolute rest is enjoined. Visitors are not permitted, and so far as possible, the mind is kept free of anxiety, worry, or any mental strain. The sponge bath and alcohol rubs are continued as usual, and for high temperature, cool sponging is added. Application of the ice bag to the head or affected side, or both, is very beneficial. After each feeding, the mouth must be cleaned with 4 per cent boric acid or Dobell's solution of one-fourth to one-half strength. For the dry mouth, a mixture of four equal parts of albolene[9] and 2 per cent boric acid solution, flavored with fruit juice may be applied.

Water is given in abundance by mouth. A pitcher of cool water is placed at the bedside, and at least a glassful every hour is given. It may be necessary to give water per rectum, or under the skin, but under no circumstances should one neglect the simple and continuous washing of the system with this medium.

The diet does not differ from regular operative patients, except that the patient is given small frequent feeding with an increase of sodium chloride, in lobar pneumonia cases. No distention of stomach or intestines must be tolerated, as this especially embarrasses the heart action. The attention given the bowels and urinary bladder, differs in no way from an ordinary laparotomy case.

As soon as the disease is discovered, dry cupping on the affected side should be resorted to. I have found this a most excellent practice, and feel that many cases of pneumonia are cut short by its efficient use. The following disconcerting explanation has been advanced to explain the beneficial action of cupping in this disease: "Lobar pneumonia is converted into an exanthematous fever by bringing the bacilli and their attendant toxins in the blood, into the skin, and fixing them with the blood clot, there to stimulate the production of antibodies by the skin cells.''[10]

Cupping is carried out by using special cups, designed for this purpose, or any thin glass, such as a wine glass, jelly glass, etc., may be used. The thinner the material, the less apt are they to pull off by their own weight. The principle involved is the production of a partial vacuum in the cup, which sucks the patient's skin into it and causes the mottling due to ecchymosis, which is highly desired.

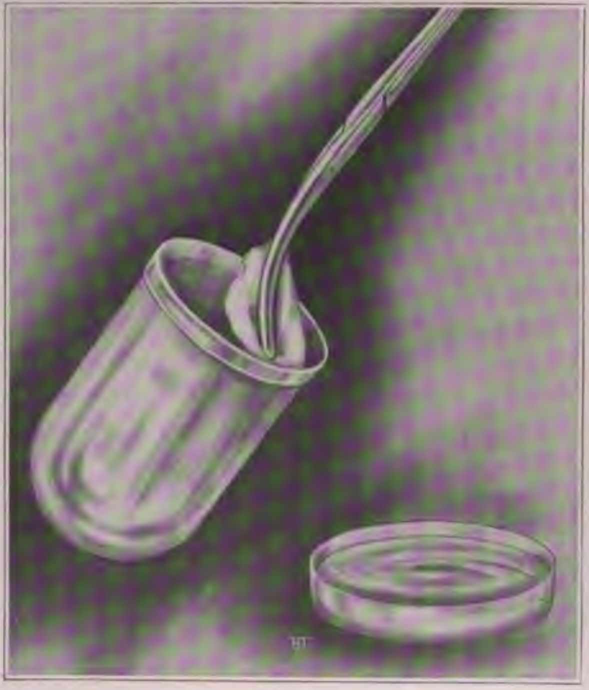

Fig. 39.—Applying alcohol to the cup.

In order to produce the vacuum, the cup is swabbed (Fig. 39) out with an alcohol sponge. The alcohol is then set afire (Fig. 40), and just before the flame goes out, the cup is applied to the body over the area of inflammation in the lung. The cups are allowed to remain until the skin becomes deeply congested (Fig. 41) from the negative pressure. At times this may become so great as to cause serum to appear on the surface. This is not desired, though it does no special harm.

One must avoid burning the patient. This is prevented if the alcohol is applied smoothly within the cup, and the outer edge wiped dry before it is applied. The process is usually carried out twice daily, and kept up until there are definite signs of improvement.

As to the medication, creosote carbonate 10 to 15 grains[11] every three or four hours, given in capsules, has proved a very good measure in some hands. It is warmly recommended by Sajous, and also by Van Zandt.[12] Mathison[13] would use potassium iodide in addition to the creosote. He states that the antiseptic action of the creosote limits the extension of the process, and the iodide loosens the exudate. Both drugs tend to quiet the heart and both have a diuretic action.

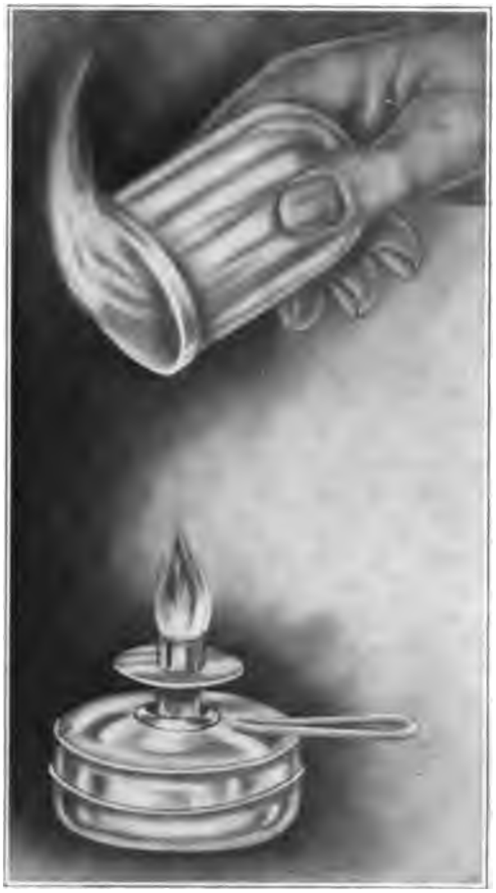

Fig. 40.—Igniting the alcohol.

The heart is further supported by giving digitalein or tr. digitalis, 8 to 10 minims, every three or four hours. If there is excessive pulmonary pressure, tr. belladonna, 5 to 8 minims, also may be given with the digitalis. If there is any disease which hinders free conductivity of the auricular impulse to the ventricles, digitalis should not be given, but other stimulants, such at pituitrin, caffeine, camphorated oil or strychnine may be given.

The cough of pneumonia may be due to the bronchitis or to pleurisy. If the cupping does not relieve the condition with its associated pain, codeine sulphate, in small doses ($\frac{1}{8}$ to $\frac{1}{2}$ grains) repeated often, should be administered. Morphine may be necessary to relieve the pain.

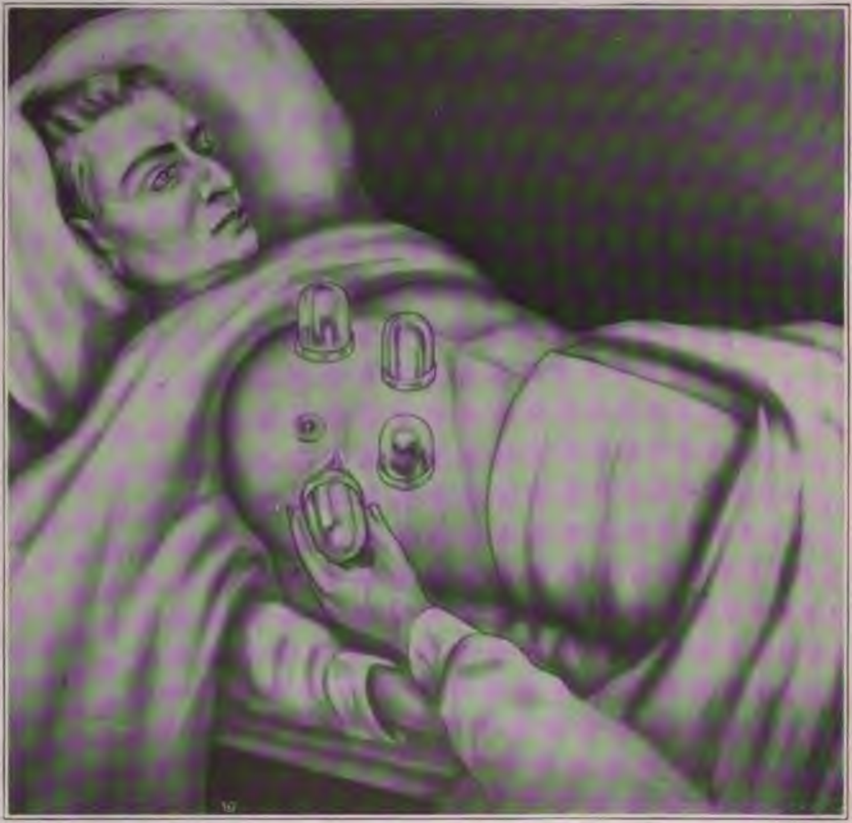

Fig. 41.—Three cups in place. The fourth is being slapped on just before the fire completely disappears.

For further treatment, the reader is referred to works on medicine.

Pulmonary complications, other than actual pneumonia, are frequently observed in postoperative patients. Acute bronchitis, with or without an associated congestion of the lungs, is by far the most frequent complication seen in the respiratory tract after surgical procedures. This condition is most likely to occur in patients who have had subacute colds before the operation, or in patients suffering with chronic bronchitis, or some other chronic affection of the lungs. The temperature may not be very high, though in some cases it rises to 103° F. or more.

Associated with the excessive amount of mucus or mucopurulent material which is expectorated, there is increased respiration, fast pulse, and general evidences of serious illness. The severe symptoms usually disappear with seventy-two hours, although the cough remains for a number of days. In cases where acute congestion of the air passages occurs without a prolongation of the cough, the temperature is not so high or the symptoms so marked as in the bronchitis cases.

Pulmonary edema has never occurred in any of my cases, though it has been reported by others.[14] The condition is due to escape of serum through the vascular walls into the alveolar wall and the alveoli.[15] It is associated with pulmonary congestion, and appears most often bilaterally. The malady occurs suddenly, more frequently in patients already suffering with Bright's disease,[16] and often proves fatal.

The chief symptoms are extreme dyspnea, cyanosis, cough, expectoration of frothy seromucous fluid and profound prostration. The patient usually dies of heart failure and carbon dioxide poisoning. Those who recover usually do so suddenly.[17]

The treatment of bronchitis is the same as outlined for pneumonia. In addition, I usually subject the patient to steam. This is administered by utilizing a specially devised croup kettle, in the nozzle of which a little cotton, moistened with tincture of benzoin, is placed, and the medicated steam is inhaled by the patient. In order to get the full benefit of the steam, a cone is made of paper and this arranged over the nozzle of the kettle; the patient then places his nose and mouth in the largest end of the paper cone and inhales the steam. Expectorants, such as syrup of white pine, teaspoonful every three hours, or ammonium chloride, three to five grains every three hours may be employed. For the congestion of the lungs we have never found any remedy which surpasses cupping. This is used in connection with regular treatment for bronchitis.

Pulmonary edema requires quick and efficient measures. Artificial respiration is probably most effective in tiding the patient over an acute attack. Cases are reported[18] where this measure alone has saved patients from an untimely death. If the blood pressure is high, venesection, with the escape of 500 c.c. of blood is advised. Atropine sulphate, 1/100 grain, and repeated in half-hour or hour intervals, until the physiologic effect is produced, may prove of value. The patient is changed frequently to prevent hypostatic congestion, and the heart action supported by digalein, caffeine, pituitrin or strophanthus.

Pleurisy

Pleurisy is occasionally seen in postoperative patients. In our experience, it occurs most frequently after high abdominal operations, particularly those associated with peritonitis. Bibergeil,[19] in 1905, found 16 cases of pleurisy with effusion, out of 3909 abdominal operations. Burnham,[20] in 1914, found dry pleurisy occurring 45 times, and pleurisy with effusion 14 times in 13,013 operations.

Symptoms.—The symptoms of pleurisy are initiated by severe pain on the affected side, which is particularly excruciating when the patient takes a breath. It usually precedes the temperature a day or so. The affection is more common on the right side. Diaphragmatic pleurisy is probably very commonly associated with involvement of the base of the lung.[21] This in itself produces painful deglutition and breathing, which forces the patient to use the upper thorax during respiration.

The signs of dry pleurisy are chiefly the friction rub, which may be heard directly over the lesion. This being absent, the condition may be mistaken for pleurodynia or costal neuralgia. The presence of fever eliminates these conditions. Where effusion is present, depending upon the amount, of course, the chest movements are limited, there is dullness, absence of tactile fremitus and vocal resonance, weakness or absence of the respiratory sounds and the heart may be displaced to the opposite side of the effusion. In such effusions, Grocci, in 1902, described a paravertebral triangular area of dullness on the side opposite that of the effusion. This sign is present in practically every case. The x-ray[22] may be used to good advantage in clearing up the diagnosis. Exploration of the chest, with an aspirating needle, should be done in all cases presenting the above signs, and the fluid obtained should be carefully examined for pus cells and bacteria.

The leucocyte count, in cases with serous effusion in Burnham's cases, was around thirteen thousand. Morse[23] states that if there is a continuous leucocytosis in these cases, there is certainly some complication elsewhere.

Treatment.—The treatment is expectant. Dry cupping is indeed a good remedy for this condition. Cases of dry pleurisy are at once cut short. Where serous effusion occurs, however, frequent aspirations, in addition to the cupping, is advised. In doing the paracentesis, in addition to aseptic care, one must bear in mind, that syncope and even death, has followed this simple procedure. Some would give a mild stimulant such as an ounce of whiskey. All the fluid should not be withdrawn at one time. It is necessary to remove only that amount which will remove all symptoms.

The results following a failure to observe this rule are at times albuminous expectoration, cough, or even edema of the lungs may occur. I, therefore, have my patients in bed, when this procedure is necessary, as advised by Forchheimer,[24] and on the first appearance of faintness, severe cough, or feeling tight around the waist, the operation is at once stopped.

The patient will lie on the affected side, and there is no objection to this position, but he must continue to practice deep respiration. The affected side may be immobilized with adhesive strips, the first being applied, however, at the end of expiration. All patients with any pulmonary complications, should be removed to the rooms set apart for pneumonia, where fresh air and sunlight may be had in abundance.

Empyema may follow a pleural effusion, or it may occur as a direct complication. Bibergeil found fourteen in the cases analyzed by him, and Burnham found six. Beckman found three in his series of cases. This condition most often occurs after operations for perforated gastric or duodenal ulcer, or suppurative appendicitis, associated with a peritonitis, either local or general. In a majority of the cases, subphrenic abscess also is found, and this malady apparently has a definite relation to empyema, or the pleural affection may be the cause of the abscess in the abdomen. In our experience, we can heartily agree with Gee and Harder,[25] that "Pleuritic effusion, following abdominal infections is more often purulent than serous."

The symptoms are more or less general. The temperature after the operation may fall to normal, only to rise again—slowly, however, as the disease becomes more and more severe. It often reaches 104°. It may remain high, with remissions, until just before death, when it falls to subnormal. In some cases, a hyperpyrexia occurs at this time, the temperature going to 107° or 108°. There are chills and chilly sensations preceding the rise in temperature at times, which are followed by sweats. The pain and general physical signs are about the same as seen in pleurisy with effusion. The most important point in diagnosis is the examination of the aspirated fluid.

The fluid may be purulent from the start, but it is usually reddish or yellowish in color, and turbid. Burnham feels that turbid exudates will soon pass into pus exudates, while a clear sterile fluid is most likely to resorb without pus formation.

The prognosis is bad. In all of Burnham's cases the patients died. It is extremely fatal in very young patients, and in the aged. Fortunately the disease most often occurs in middle-aged adults, but even among these a large percentage of postoperative empyema cases die.

Empyema is further discussed on pages 294 and 732.

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CHAPTER XXXV

PAROTITIS

By O. F. McKittrick, St. Louis, Mo.

Inflammation of the salivary glands, particularly the parotid, occurs occasionally after operative procedures, especially those involving the pelvic organs. The complication, as a rule, is of very serious import, one demanding instant attention regardless of the fact that it may at first appear innocent and apparently occasioning no alarm.

The literature on postoperative parotitis is limited, few men having considered the subject worthy of the study it most certainly deserves. Fowler[1] stated that he had seen it occur eight times in patients after undergoing laparotomies. Four of these cases were observed after operations upon the adnexa, one after operative interference for extrauterine pregnancy and two after operations for appendicitis. We have seen this complication develop five times. Twice in patients operated for appendicitis, one being a most violent suppurative case. Once after intestinal suture (ileal) and abdominal drainage three days, following a kick in the abdomen by a horse, once after removing a single pyosalpinx during the course of a general puerperal septicemia. The last case to develop a parotitis was a cancer of the rectum in which an anterior left-sided colostomy was done. At the same time a Kraske was performed.

Blair[2] has treated this condition in three postoperative cases. One occurred after operation for suppurative appendicitis and two others following operative procedures for inflammatory pelvic disturbances.

This disease occurring in patients other than those convalescing from surgical procedures does not concern us here. However, it is so frequenty associated with the infectious diseases such as typhoid fever, cholera, typhus, scarlet fever, pneumonia, erysipelas, dysentery, etc., and other infectious conditions such as septicemia or pyemia that it is not surprising that it should occur so frequently in the cases presenting some abdominal inflammation.

Acute inflammation of the salivary glands, by far most commonly noted in the parotid, is due to infections either metastatic in nature or ascending up the excretory ducts. Any infectious process such as mentioned above may be an inciting factor. Local conditions within the mouth certainly add to the predisposition for infection. During any operation performed under a general anesthetic the salivary secretions decrease in amount following the first stimulating influences. For the first few days the patient is given a liquid diet which neither entails actual use of the jaws nor stimulation of the salivary secretions. As a result the inactive glands, whose resistance has already been lowered by the operative procedure, invite invasion from the myriads of microorganisms retained in the mouth. Their entry through the excretory ducts is soon followed by most active proliferation within the substance of the gland which furnishes an excellent soil for growth and development. Direct trauma from ulcerated teeth or manipulation by the anesthetist may occasionally be followed by this condition.

In this connection trauma of the abdominal viscera, of the testicle or ovary or of the other pelvic organs, has occasioned a parotitis. Crandall[3] states that it has been observed in facial paralysis, neuritis, diabetes, and even from poisoning due to mercury, to lead, or to the iodides. It has also occurred in the course of rectal feeding, a matter which deserves attention.[4]

Crandon[5] notes that "it may follow any injury or disease, but it is more frequent after injuries and operations on the pelvic organs than after diseases in any other part of the body."

From the experiences of others parotitis in the surgical convalescent appears more frequently in women.[6] All of Fowler's cases and two of Blair's were of this sex. Of my own, however, only two were women.

Rhodes[7] has recently reviewed the literature of subacute and chronic inflammations of the salivary glands, not postoperative. His findings in the forty cases reported, seemingly do not bear out the general opinion that the female is more liable to the disease than the male. Probably the fact that more women undergo operations than men accounts for the apparent discrepancy.

Rhodes states that "the condition, if not bilateral from the start, tends to become so," but more than one pair of the glands were not involved except in two of the cases reviewed by him. In these he noted that all the salivary glands were affected. He also found that the parotid glands were involved in 56.4 per cent, the submaxillary glands in 30.7 per cent, the sublingual glands, 7.6 per cent, and all the glands in 5.3 per cent of the cases reported.

The course of this disease is about one week in postoperative cases, but unless treatment is instituted, the disease remains longer and always tends to progress, though a few instances have spontaneously subsided. It is not advisable, however, to await such a favorable outcome, but the worst should be expected and prepared for in every case. Rhodes states, concerning the subacute and chronic types that "there is apparently no tendency to abscess formation. In fact abscess formation would appear to be confined to cases of obstruction by stone and metastatic infection." Postoperative parotitis being the result, in the majority of the cases, of this latter condition, the complication mentioned above certainly is to be expected.

Symptoms.—The symptoms appear usually within three to ten days after the operation, though in one of Fowler's cases they did not appear until eighteen days. There occurs a rise in temperature with an accompanying rise in pulse rate and in most of the cases the individual is extremely ill. The temperature continues to rise until 104 or 105 degrees is reached. Very soon a swelling, usually just in front of the lobe of the ear, is seen, since as Blair has said, the capsule is less dense here and (as mentioned before) the parotid gland is more frequently involved. Later the whole gland becomes affected, causing the face and cheek to swell and the lips and eyelids to become edematous. In the most severe cases the swelling may be so rapid that the edema quickly obscures the real cause of the trouble. The skin may present a shiny appearance or even discoloration, the whole picture being that of an acute septic process which is localized in the side of the face and neck. The pain from the start is most intense owing to the resistance the tense capsule offers to the swelling gland. In the vast majority of the cases pus formation soon occurs. An examination of the parotid papilla reveals this region of the mouth swollen and as Blair has interpreted it, the congested mucous membrane lining of the duct may be noted at the apex as a dark red spot. Saliva will have ceased to be excreted in many instances and on gentle pressure pus may be easily expressed. In the worst cases extensive suppuration takes place, the pus burrowing in every direction. Unless liberated by early incision, the external auditory canal is frequently the first to be broken into, though invasion of the deep cervical and thoracic tissues, the retropharyngeal space and even the maxillary joint may quickly occur. Blair notes that through the olivary foramen the infection may enter the cranial cavity. Thrombosis of the veins here or in other portions of the body may result.

In the milder class of cases there may be only a localized swelling which disappears within a few days or else develops into a localized abscess within the gland substance. In the severe cases, however, the diffuse suppuration which is almost always seen in those patients with poor resistance and otherwise debilitated, is simply in many instances, the beginning of the end, and the most extensive measures employed in combating the difficulty can only be palliative. The prognosis depends upon the condition of the patient at the beginning of the outset of symptoms.

When these appear late in a complicated convalescence in a well preserved patient even the most severe infection does not prove fatal. In those individuals already weakened by disease, debilitated and presenting some suppurative condition in the abdominal cavity the prognosis is extremely grave and unless thorough and prompt surgical measures are at once undertaken the patients almost always die.

Of the cases reported by Fowler, however, none died and only one of the cases presented a bilateral infection. In my own experience such a fortunate outcome was not seen. Two of the patients and the one was the case of ruptured intestines following trauma, a boy of sixteen died within four days after the first appearance of the gland affection three days after the operation. The other was the case of puerperal septicemia in which salpingectomy was done and the general postoperative course was uneventful until the fifth day when the temperature which had been normal two days shot up to 103° with attendant soreness and swelling in the region of the right parotid gland and neck. The patient rapidly became prostrated and within thirty six hours there was marked fluctuation just below the parotid. Considerable pus was drained, but twelve hours later the swelling not having decreased, but rather increased, particularly in the parotid region, extensive incisions were made in every direction and the gland capsule widely opened. In spite of this the patient succumbed after a few days of intense suffering from general septicemia.

Both these cases presented only a unilateral parotitis. The three patients who recovered had a bilateral affection and in each instance the glands were widely drained after the Blair technic within twelve hours after the beginning of the infection in each of the parotid glands and the adjacent regions. The operations were carried out under gas anesthesia and were quickly done, the wounds being left wide open with gauze drainage only.

Blair's postoperative cases were also less fortunate even than ours. Only one of his cases recovered, the other two dying of a general septicemia despite the most radical exposure of the infected regions.

Treatment.—The treatment is first and always preventive. It has been our custom to allow patients to chew gum, beginning the first postoperative day and continuing to do so until they start to take solid food. The mouth is kept scrupulously clean by washing with some alkaline antiseptic mouth wash and scrubbing the teeth twice a day. The patient is given a bread crust or some other solid food to chew to stimulate the salivary secretion and other digestive secretions in order to avoid this possible complication. Patients who are prone to sleep with the mouth open or those subject to mouth breathing, particularly when recumbent, are protected by keeping six layers of 15 x 15 mesh gauze (Fig. 42) moistened with a solution of half water and half glycerin over this orifice. Such a maneuver prevents the dryness of the mouth and the attendant dangers occurring in these patients. If in spite of these measures infection occurs of the parotid, Müller's[8] suggestion may be tried during the preliminary study of the condition. This consists in gently massaging the parotid to determine whether any pus exudes from Stenson's duct. If this is present, it is carefully expressed. If pus is not obtained according to Müller there is no reason to suspect metastatic parotitis and massage must not be en-

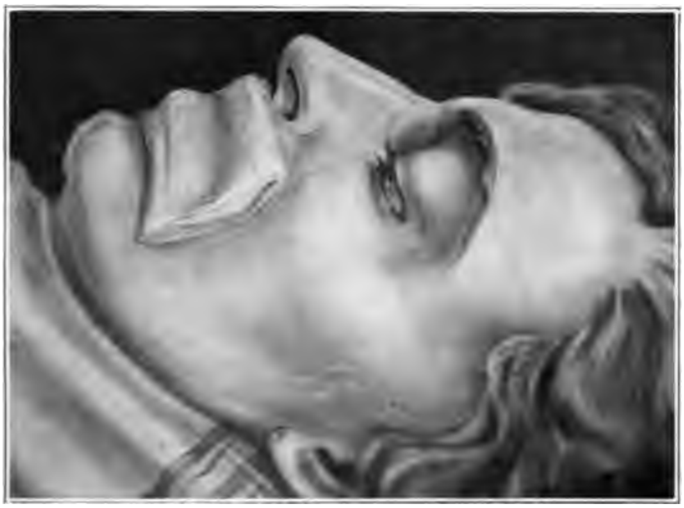

Fig. 42.—Gauze moistened in equal parts of glycerin and water to prevent the open mouth from drying.

tertained. In the meantime ice is applied directly over the region of the injection.

Blair states that "if suppuration occurs it will usually be on the third or fourth day and be accompanied by an increase of all symptoms. This is the proper time for radical treatment. If especially tender or softened spots can be found, these may be opened by an incision down to the capsule. A round-nosed conical artery forceps should then be inserted, but in the presence of severe symptoms the surgeon should not wait for definite fluctuation, which owing to the tenseness of the capsule, may never be evident. In such cases radical treatment may be urgently necessary within twenty-four hours after the first appearance of the symptoms. Here in the absence of any local softening, an incision should be made just in front of the ear from the zygoma to the angle of the jaw down to the capsule and the flap forcefully drawn forward with sharp hooked retractors. If there is edema of the neck the incision may extend to the clavicle through the deep cervical fascia, the trunk and branches of the seventh nerve lie deep in the gland, near its posterior part, and will not be injured by any carefully made incision.

"In this way, nearly the whole gland can be exposed. By incisions carefully made through the capsule, the swollen gland will be permitted to expand, which will increase its blood supply and lessen the danger of gangrene.

"If pus does not come on opening the capsule, the substance of the gland can be explored at various points by inserting a round-nosed artery forceps, not overlooking the prolongation of the gland that runs forward with the first part of the duct. If more radical exposure of the capsule is made, the latter should be incised in a number of places, thus decreasing the tension in every part of the gland. Failure to do this in one of the writer's cases made it later necessary to reopen the capsule of that part of the gland that runs forward with the first part of the duct. The operation requires but a few minutes under a gas anesthesia, and the wound is packed wide open."

When the submaxillary or sublingual glands are involved they are incised and allowance made for free drainage. The wound later is to be treated as any other infection, and as it begins to granulate, careful attention should be given the skin edges to keep them approximated with adhesive to avoid extensive scarring. As a rule very little scar follows such operations if the proper attention has been given the healing wound.

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CHAPTER XXXVI

SUBDIAPHRAGMATIC EMPYEMA (Localized)

By O. F. McKittrick, St. Louis, Mo.

The misnomer subphrenic abscess is an uncommon affection, as Jopson[1] has rightly stated, but a perusal of the literature will readily convince one that it must be reckoned with. Localized collections of pus which are situated immediately beneath and in contact with the diaphragm are found following operations, particularly operations for appendicitis.

The condition was described as early as 1829 by Wright[2] and one year later Graves and Stokes reported a patient dying from this complication. Barlow and Wilks[3] in 1845 were the first to distinguish between the signs referable to perforating gastric ulcer and pneumothorax. Later on other cases were reported by Duchek,[4] Bamberger,[5] and Bernheim.[6] Von Volkmann in 1879 first operated for the condition and since that time many men, including Patsch,[7] Taylor,[8] Fitz[9] and Leydon,[10] have reported cases, particularly following appendicitis. Of late years Treves[11] has reported 6, and Ross[12] 31 instances following appendectomies.

The causes of this complication besides those already mentioned are varied indeed. Anything capable of producing local peritonitis beneath the diaphragm may give rise to a subdiaphragmatic abscess. Following appendicitis, perforations of the stomach and duodenum, come liver abscesses, suppurative cholecystitis, perinephritis, pancreatitis, perforation of the colon, etc. The condition has also followed tonsillitis, influenza and boils.

The mode of infection of the subphrenic spaces following disease of the appendix especially has been carefully worked out from anatomic, clinical, and experimental standpoints by Barnard,[13] Lance,[14] and Cosentino,[15] respectively. They agree that it is a part of the general peritonitis (the cases of true localized subphrenic abscesses being excluded). Infection may be carried by the blood or it may occur by direct extension up the lower peritoneal fossa by lymphatic extension either up the right retroperitoneal cellular tissue or up the lymphatics around the deep epigastric artery to the falciform ligament. In rare instances the portal vein served as the medium through which the infection occurred. According to Ross extension up the peritoneal fossa is by far more common. Barnard has divided all subphrenic abscesses according to their location as regards the falciform and lateral ligaments. By this arrangement he recognizes anterior and posterior intraperitoneal abscesses on each side and right and left extraperitoneal abscesses.

A right anterior intraperitoneal abscess would then be located between the upper surface of the right lobe of the liver and the diaphragm. The one posteriorly would be bounded by the liver and gall bladder in front and the abdominal parietes behind.

A left anterior intraperitoneal abscess or splenic abscess would be bounded by the diaphragm above, the liver below and to the right, and the spleen on the left. The one posteriorly would be situated in the lesser peritoneal cavity.

A right extraperitoneal subphrenic abscess lies in the space between the layers of the coronary and other peritoneal ligaments of the liver. The left extraperitoneal abscess would have like boundaries on the left side.

Others, however, feel this distinction is hardly necessary and have excluded the extraperitoneal spaces. Taking the suspensory ligament as a dividing line, then, those abscesses of appendiceal, hepatic or duodenal origin, are located to the right of this ligament; while abscesses arising as a consequence of gastric perforation, or inflammation of the pancreas or spleen are found to the left. The mesentery of the transverse colon prevents the downward extension of the process and the colon with the omentum walls off the abscess from the greater peritoneal cavity. Recently Judd[16] has called attention to the extraperitoneal spaces in their relation to pus from the kidneys. He states that though it may be difficult to determine clinically which one of the pouches contain the infection, a detailed knowledge of their boundaries is important. He further adds that one or more of the spaces may be involved at the same time.

In the majority of cases the abscess occurs on the right side. In nearly all of twelve cases reported by Barnes and in 29 of Ross' cases was the location in this region.

Subdiaphragmatic abscess occurs more often in men than women, the time of life being around the third decade. It is comparatively rare under 14 years of age, occurring only once following 500 consecutive operations for appendicitis reported by Ross. In 3391 such consecutive operations this same author found the condition to occur in .8 per cent of the cases. On 410 consecutive autopsies, Kelly and Hurdon[17] found the malady 13 times; in more than 50 per cent of the cases the affection was appendiceal in origin. Lance collected 943 cases of subdiaphragmatic abscess, 222 of which were due to acute appendicitis. Piquand[18] reviewed 890 instances of this condition and recorded 191 as being due to appendiceal affection. Of the cases reported by Judd, 9 were associated with appendectomies, 7 with gall bladder operations, 7 with ruptured duodenum, 4 with ruptured gall bladder, 2 with perforating gastric ulcers, 1 with general peritonitis, 1 with a tuberculous lesion elsewhere in the body, four with focal infections and one following an operation on the stomach.

The contents of the abscess varies with the organ involved. The pus may contain bile, carious bone, or caseous material, but usually it is very foul, as is the fact when the appendix is primarily involved. In many of the cases gas alone or gas with but little pus may be present. Various reasons are ascribed for this but it is probably due to bacterial proliferation, the colon bacillus being usually found.

Symptoms.—The symptoms of subphrenic abscess vary from those of a very mild infection with practically no rise in temperature and pulse and no leucocytosis, to the most severe type of peritonitis. Usually the patient will complain of pain in the right side in attempting to take a full breath. Chilly sensations are followed by chills, fever, sweating and the pain increases in severity so that the patient is able to take only very shallow breaths. A cough develops with the irritation of the diaphragm. A leucocytosis now occurs and the patient settles down to a siege of sepsis. On examination an involvement of the base of the lung will be found, but there may or may not be dullness. Later on, however, there will appear an area of dullness in this region with lessened breath sounds and fremitus. It must be remembered that the line of dullness will curve upwards in this condition in contradistinction to fluid in the pleural cavity. At times these signs may be noted anteriorly and in addition pleural friction sounds may be present. As the condition progresses there may be flattening of the intercostal spaces or bulging of the chest wall itself. The swelling may appear in the epigastrium or below the border of the ribs and be associated with a local edema, depending upon the location of the pus. The outline fluid will not change with different postures of the patient, but will remain in one position. Neither will the heart be dislocated as is seen at times in pleuritic effusions, unless possibly it is pushed upwards. In 5 of the 21 cases reported by Ross coming to autopsy there were purulent pleurisy.

Abdominal symptoms do not always occur due to the deep location of the abscess; when present, however, pain and tenderness will be noted and the mass may be felt in the epigastrium. The pain as stated above is usually a pleural pain and elicited abdominally by deep palpation. The cases in which symptoms were delayed for months, reported by Ashhurst[19] and Meisel[20] showed a more or less sudden onset and the complication was apparent as a grave abdominal condition.

When this complication presents itself, as early a diagnosis as possible should be made. Since the abscess so often contains gas which may be mistaken for a pneumothorax or even for a hollow viscus, it may not be possible to make a diagnosis without first freeing the stomach of gas by means of a stomach tube and then applying the aspirating needle to the affected side. This can give important evidence as to the location of the pus. If the abscess communicates with the pleural cavity the needle will move up and down with the respiratory movements; or by immersing the end of the needle in sterile water one may be able to see the expulsion of gas with those movements of the diaphragm. These signs will fail at times due to the localized paralysis of the diaphragm caused by the inflammation or pressure of the fluid upward. Adhesions may also produce the same effect. Only the most careful study of the individual case will effect even an approach to a diagnosis. The leucocytes in Judd's case ranged from 8,800 to 22,000. The duration of the disease varied from three days to ten months. In four of his cases the x-ray was used to good advantage in distinguishing between this condition and others above the diaphragm.

Treatment.—The treatment consists firstly in anticipation of this complication during operations, appendicitis with pus behind and to outer side of the ascending colon. The *prone* position[21] with sufficient flank drains in such cases will aid materially in preventing a subphrenic abscess from developing. This position is better than the Fowler immediately following the operation, since the heart is not put on an additional strain, while drainage is definitely assisted by the influence of gravity. After twenty-four hours the patient lies on the right side as much as possible. When the drainage ceases, he can assume any position, though he is enjoined from lying on the back very long at a time during any phase of the convalescence.

In spite of these preventive measures the condition may occur. It should always be suspected in any such case which shows more toxic symptoms than can be accounted for. An early diagnosis made by the aspirating needle or any other means at our command will materially lessen the severity of this complication.

The prognosis is thereby improved though it is serious enough under any circumstances. Depending upon the virulence of the infection, the patient may die within a few hours or he may live several months. Recovery may result by rupture of the abscess into a bronchus directly or indirectly by way of the pleura. The abscess rarely empties itself into any of the abdominal viscera or externally. Death is most apt to occur from sepsis.

The mortality depends upon the origin of the abscess and upon the date of operation employed for its relief. If such measures are attempted early, the mortality is around 16 per cent; but if delayed as late as three weeks, it goes above 50 per cent. If, however, no operation at all is done the mortality varies from 55 per cent to 72 per cent according to Sonnenberg and Sachs, respectively. Of Judd's cases, 11 died due to the extension of the process to the liver with the formation of multiple abscesses which could not be adequately drained by any operative procedure.

Under local anesthesia wide and free incisions should be made in an effort to get adequate drainage. According to Ross the various operations for this condition are classified in three groups. The abdominal operation may be carried out below the ribs, in the epigastric region or in the loin, depending upon the location of the abscess. The subpleural route consists in resecting the tenth rib in the midaxillary line and traversing the diaphragm below the pleural reflection.

Probably the transpleural route is the one preferred by most operators. The technic, as employed by Elsberg, consists in resecting the the ninth and tenth ribs somewhere between the scapular and axillary lines. The surfaces of the pleura should be carefully sewed together to prevent pus from disseminating throughout the thoracic cavity. Large rubber tubes should be employed and the patient treated the same as an empyema case. No matter where the drain is inserted, the patient must be so placed that the opening coincides with the dependent portion of the body. The most effective and complete drainage is secured in this way alone.

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CHAPTER XXXVII

THROMBOPHLEBITIS

By O. F. McKittrick, St. Louis, Mo.

Postoperative thrombophlebitis is of such common occurrence that it enters into the experience of every surgeon, and yet, notwithstanding the advance in postoperative treatment in recent years, it is still so common and the consequences may be so dire that it remains a bête noire of the surgical profession.

This condition occurs most frequently after abdominal operations, but it may follow operations on distant parts of the body.[1] It is especially common after operations on the uterus and adnexa and in operations about the rectum. This condition rarely occurs before the age of puberty, and with the greatest frequency after thirty. Thrombophlebitis develops in clean, as well as septic cases;[1] the thrombosis forming at times far from the operative field. The left (due to the right common iliac artery crossing in front of the left common iliac vein) femoral vein and the veins of the calf and thigh are most commonly affected, though the external iliac, the common iliac, the mesenteric, and the portal veins have been involved in this malady. From a study of a large series of statistics, thrombophlebitis occurs in from .81 per cent to 3.6 per cent of all laparotomies. Burnham[2] reported the former, and Friedman,[3] the latter figure. It was also noted that the earliest onset of the disease came after four days, and the latest onset after twenty-eight days. Generally debilitated or anemic subjects, those who have suffered from profuse and prolonged menorrhagia due to the presence of a submucous fibroid, or those who have been subjected to a prolonged operation, formed the bulk of the patients affected as above. I saw fatal disease of the long saphenous vein follow an operation near a varicose ulcer.

More than sixty years ago Virchow called attention to thrombosis; and although he did not distinguish it from coagulation,[4] his studies were early confirmed by numerous experimental and postmortem observations by others, chief among whom were, Cohnheim and Cohn; when with this work we place Welch's classical review of "Thrombosis and Embolism" published in 1899, we have listed most of the significant literature on this subject.[5]

Today the meaning of the term has changed and by thrombosis is meant the formation and organization, during life, of a blood clot in a vessel. The mechanism is so simple, as it is taught at the present time that we wonder why it was necessary for Virchow to establish the self-evident fact that injury to a vessel or changes in the blood sufficient to cause clotting at some particular point might be followed by dislodgment of a piece of the solid clot, and this broken off mass be carried on by the blood stream, until it reached a vessel too small for it to pass through, then stop. It is also plain that the blocking of a vessel by this solid mass would stop the circulation through this vessel, and give rise to disturbances of great importance, or of little importance, depending on whether or not this vessel supplied an organ, the function of which was necessary to maintain life. Increased coagulability is probably not alone responsible for thrombosis, though Wright and Knapp,[6] in 1902 stated that thrombosis, particularly after typhoid, was due to increased coagulability of the blood, as the consequence of the high calcium content which they attributed to the milk diet.

The modern theory, which is generally accepted, is in accord with the teaching of Eberth and Schimmelbusch, who believe that the blood platelets play a prominent part in thrombosis, but little or no part in coagulation. On the other hand, fibrin and its progeners although normally active in coagulation, play only a minor part in the formation of a thrombus. Blood platelets, numbering from 180,000 to 780,000 per c.mm., according to Bizzero, although normal constituents of the blood, are the originators of the typical thrombus. They may collect about a foreign body or following a slowing of the blood stream, collect upon the damaged wall of a vessel. This agglutinative process takes place only in the circulating blood, for there is no thrombus formation when a vein is doubly ligatured and excised, according to Baumgarten. Following the throwing down of the blood platelets there is a rapid accumulation of polymorphonuclear leucocytes, and to this nucleus is added fibrin mixed with red cells.

Aschoff states that a change in the character of the blood is necessary for thrombus formation. He holds that the location of the thrombus is determined by slowing of the blood stream, or by the widening of the vein, with resulting eddy formation; from repeated examinations of the blood Burnham concludes that there is no decrease in the coagulation time in postoperative thrombophlebitis, and while it has been suggested that an increased viscosity will cause a slowing of the blood stream, it has not been sufficiently tested in postoperative cases. Bachman has shown that it is increased in infectious diseases, especially typhoid, while it has been definitely proved that in those diseases in which the blood platelets are increased, thrombosis is common.

Chemical changes may influence the formation of thrombi. Sahli and Egnet showed that they did not form after the injection of leech extract, since the blood was rendered noncoagulable, while Schimmelbusch, on the other hand, was able to cause a formation of experimental thrombi after destroying the coagulability of the blood by the injection of peptone.

Faucheaux's[7] belief that the increased sodium content of the blood due to a temporary insufficiency of the kidney, may be a predisposing cause, is not convincing.

Albanus[8] gives as prevailing causes for thrombosis after laparotomies, "sepsis, heart derangements, pressure of tumors on veins, cooling and handling of blood vessels while the abdomen is open; the effect of narcosis on the heart, the recumbent position and the pressure of a bandage."

Infection apparently plays a part, though no definite proof can be cited for or against this. Heidemann has called attention to the period of incubation and holds the entire process to be infectious in character. Klein[9] argues against this and points to the afebrile cases as an argument against infection; but as pointed out by Fromme, many slight rises of temperature may be overlooked, and moreover, infection may occur without any febrile reaction whatever, Lubarsch could demonstrate organisms in only 20 out of 215 cases.

After an examination of a large number of records it is impossible to exclude the process as a result of the milder self-limiting types of nonpyogenic inflammations. That it may be initiated by mechanical or chemical factors or both is doubtless true, but the course and symptoms of the disease are too typical of infections to allow of any other conclusion in most instances.

Then it seems to me, as it was also suggested by Wilson[10] that the most important factors concerned in extensive postoperative thrombosis are the following:*

(a) Injury of the vessel walls. Injury to the intima by cutting, ligating or clamping causes a rapid deposite of a fibrinous thrombus, formed as depicted in the theory of Eberth and Schimmelbusch. The deposit confines itself within an area close to the injury, the endothelium quickly extends, and after a few days covers it entirely, thereby preventing portions becoming detached and forming emboli. However, there are other instances in which this limitation fails to occur and the small attached thrombi develop into large loose ones through the agencies of other factors.

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*Much of the following is taken from Wilson's article.[10]

(b) Slowing of the blood stream. Following operations the rapidity and volume of the current in the veins are materially lessened for a considerable distance nearest the first incoming venous radicals. The patient being kept quiet and in the recumbent posture causes a slowing of the heart's action and diminishes its force, thereby causing a general slowing of the blood current throughout the entire vascular system. This, according to Opie, produces a disarrangement in the blood cells, the white cells and platelets reaching the periphery of the stream tend to attach themselves to the vascular walls. In the presence of obstacles or marked expansion of the vessel a whirling motion, as shown by von Recklinghausen, may be set up which further tends to the retardation of the blood stream and to the deposition of its elements as thrombi.

(c) Destruction of corpuscles from toxic substances. From the high percentage of postoperative thrombosis and embolism following gall bladder operations and the behavior of cases suffering from severe secondary anemias and hepatic diseases, to say nothing of thrombosis in carcinoma cases, it is fair to assume that some toxic substance or substances not definitely known are present in the blood.

(d) Bacteriemia. It is now fairly well established that bacteria and their toxins are the chief causes of extensive postoperative thrombosis, many thrombi which we formerly regarded as "marantic," in the light of the last decade of pathologic advancement, we now know are of infective origin. It is readily conceivable that bacteria in the blood stream may have their virulence sufficiently reduced to prevent them setting up a local phlebitis until aided by postoperative traumatism of the intima, by postoperative slowing of the blood current, or perhaps even by the effect on the leucocytes of a prolonged general anesthetic.

Symptoms.—The symptoms of thrombophlebitis depend upon the location of the thrombus. In rare instances in which the portal vein is involved, the course is very rapid, marked by extreme prostration, chills and an irregular high temperature. The condition simulates very closely that of acute peritonitis. There is usually tenderness along the outer border of the right rectus muscle, enlargement of the liver and spleen and at times jaundice may be present. Such a condition following appendectomy is highly suspicious of pylephlebitis. Affection of the mesenteric artery is more common, and from the statisties, the sudden onset of acute pain, more or less diffuse over the entire abdomen with a decided rigidity with vomiting, usually blood stained, and in the very early stage, diarrhea with bloody stools, are the most constant symptoms.[11] Gerherdt[12] notes in addition to the above, ileus, fluid in the abdomen, a rapid fall in temperature and a large palpable mass between the layers of the mesentery. Fortunately where the condition is most common the symptom-complex is pathognomonic. Blood clots in the veins of the pelvis or lower extremities, offer no symptoms to attract attention so long as they are not infected. When infection occurs, however, a mild initiative chill is noted, followed by a temperature probably 103° C. with a corresponding pulse. At the point of the lesion there will be tenderness and swelling and the whole limb on the affected side may become swollen and painful. If the saphenous vein is involved, the veins distal to the affected portion stand out like cords, their course being marked by the red lines upon the skin over them, due to the accompanying lymphangitis.

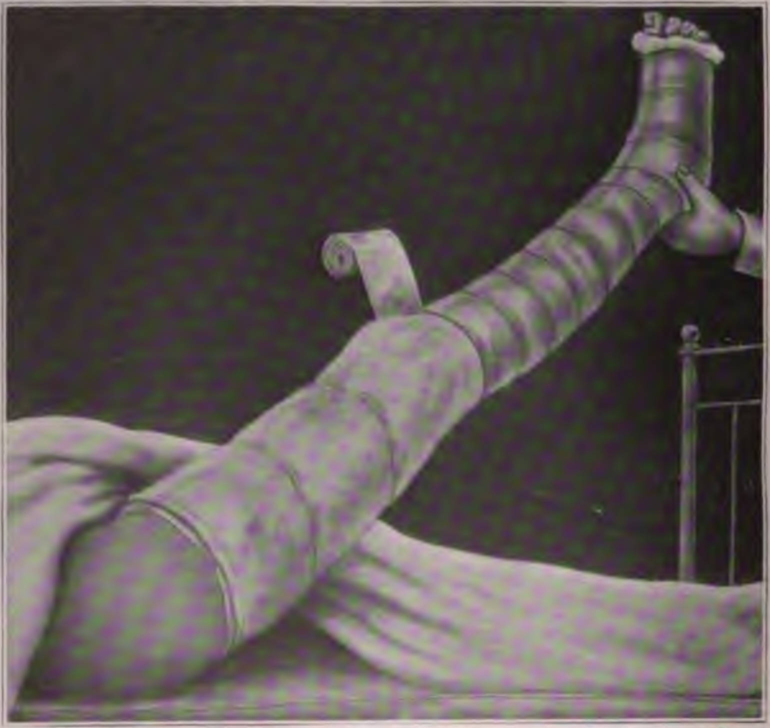

Fig. 43.—Wrapping the leg in common cotton batting.

Treatment.—In view of the facts elucidated above, the treatment of thrombophlebitis concerns itself first with the prevention of this condition. The following suggest themselves:*

(a) The reduction of vascular traumatism to a minimum at operation by the conservative occlusion of vessels and the provision of free drainage to prevent later external pressure on the vessels.

(b) The encouragement of very early free movement on the part of the patient, as soon as the nature of the operation will permit; if it can be done early enough to prevent the formation of extensive thrombi, it would seem most desirable. If, on the other hand conditions are such as to lead to the suspicion that extensive thrombi have already formed before the early movements of the patient were possible, it would then seem more desirable to keep the patient as quiet as practical in a recumbent position to prevent a dislocation of the already formed thrombi. Just when to allow the patient out of bed under such conditions depends upon the experience and skill of the surgeon. No one can estimate the time required for the formation

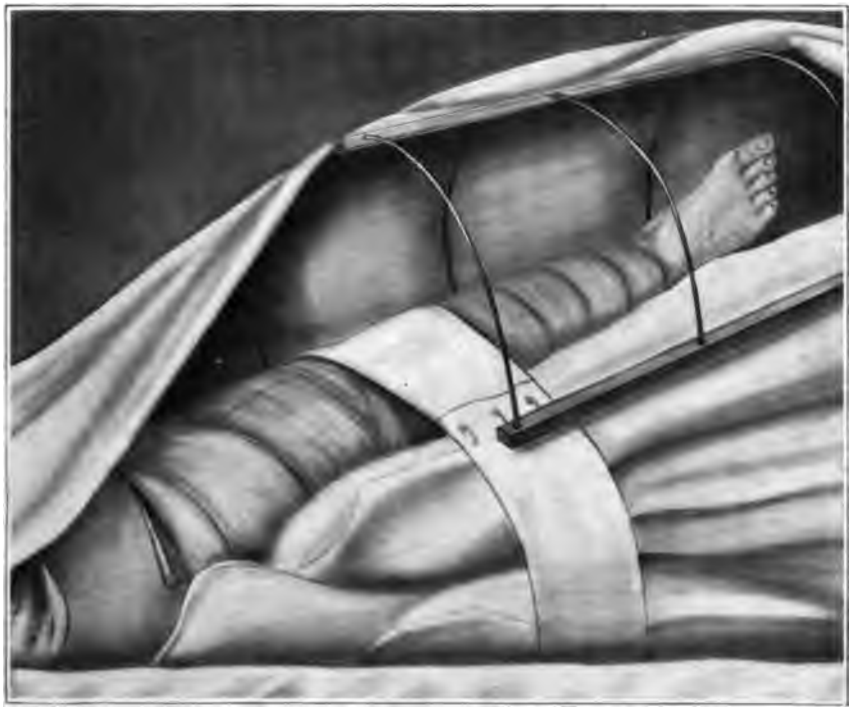

Fig. 44.—The leg is kept elevated and splinted on a pillow.

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*Much of the following is taken from Wilson's article.[10]

of extensive postoperative thrombi in any one case. We do know, however, that loose thrombi are readily dislocated by a very slight exertion on the part of the patient.

(c) The preoperative administration of drugs to increase the coagulability of the blood, as, for example, calcium salts; while these tend to produce an increased coagulation time there is no evidence to show that they are of value in thrombosis.

(d) Measures looking toward the reduction of bacteriemia are certainly indicated as a preoperative precaution. For the prevention of thrombosis the cautery should be used wherever possible at the operation to destroy the local foci. If the invading organism can be isolated, autogenous vaccines may be made and preliminary vaccination be carried out.

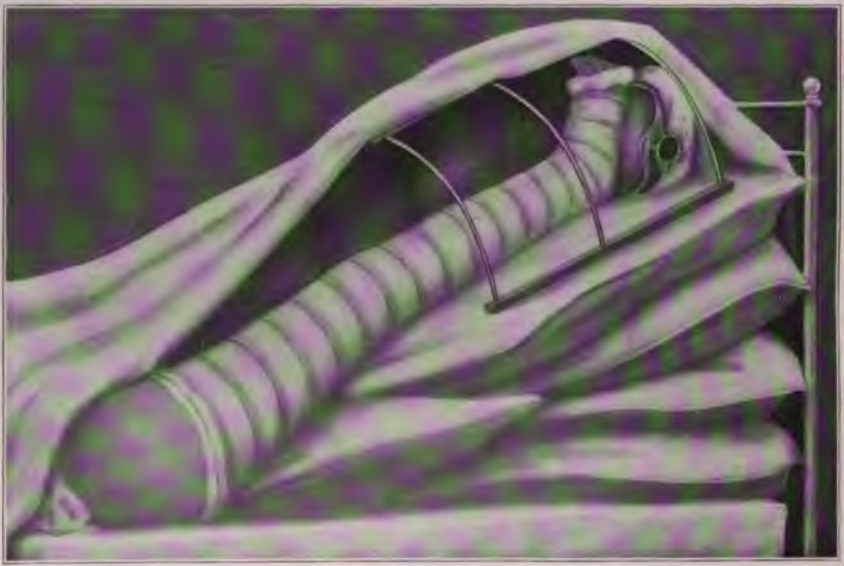

Fig. 45.—The extremity is protected from the bed covers, and a hot-water bottle applied to the sole of the foot.

Where the condition has already occurred, absolute rest in bed must be carried out for five or six weeks. Under no circumstances should the patient be allowed but the slightest movements. Particularly after the third week when the clot has become brittle and likely to disintegrate should the patient be enjoined from getting out of bed or straining at stool. The bowels can be kept normal with mineral oil given during the meals and if necessary enemas to enhance the action of this mild drug.

The leg should be wrapped (Fig. 43) in cotton and elevated (Fig. 44), hot-water bottle applied to the foot (Fig. 45), and after the acute symptoms have subsided, over the site of the lesion also. Until then ice should be placed here. Pain will thereby be relieved; but if this is not sufficient, opium may be resorted to. If necessary the vein may be opened and drained. The following history may be of interest.

February 28, 1916, Mrs. S., age twenty-four, was operated for tuberculous peritonitis and a double salpingectomy was done. The operation was quickly performed, produced very little shock, and the patient was returned to bed in good condition. The temperature was 101° at operation with a corresponding pulse; and continued so high for four days following. Urination was normal, bowels were moved with glycerin enemas on the second day and there were scarcely any gas pains. In the meantime frequent feedings of thick liquids were carried out, the food was taken with a relish and the patient felt so well that on the night of the third day she asked to sit up on the morrow. The following morning the temperature had dropped to 98.6° with a pulse of 90, and her request was about to be considered favorably when suddenly, about noon, patient noticed a stinging pain on the inner side of the ankle, which, after an hour or so, extended along the inner side of the leg and thigh. Pressure along the course of the internal saphenous vein was unbearable. The afternoon temperature was 102.4°, but there was little change in the pulse. The whole limb was well wrapped in cotton batting and elevated on a high stack of pillows. A wire cage placed over this protected the dressing from being disturbed by the bed clothes. An ice cap was placed over the lesion in the thigh and a hot-water bag at the foot. The pain was relieved at once by this treatment which never varied (except the ice cap was replaced at the end of the third day by a hot-water bag), as long as there were any indications of the lesion remaining. For nine days the morning temperature remained 101° while the afternoon temperature continued to reach the 102.4° mark. All the while patient was at perfect ease; two days following the accident the diet was increased to a general one, and a day or so later it was forced, carrots and spinach being given in abundance. At all times there was a good supply of water, sodium bicarbonate being given at times to prevent a possible acidosis. Bowels were kept open with glycerin enemas, 2 ounces every second day unless there was a movement without them. On the ninth day of the disease and the fifteenth following the operation, the temperature fell to 99°. From this time on there was very little fever. The limb was gradually lowered and after four more days' stay in the hospital with the limb horizontal, the patient was able to get out of bed, and as soon as the equilibrium became established (one day up and about the hospital), she went home. No further complication or untoward symptoms developed following the use of the limb. I attribute the quick recovery to immediate attention to the phlebitis, thereby preventing nature from forming but a small thrombus.

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CHAPTER XXXVIII

PULMONARY EMBOLISM

By Willard Bartlett, St. Louis, Mo.

When one considers that it was not until the first quarter of the seventeenth century that the circulation of the blood was discovered, it is hardly surprising that two hundred years more should have elapsed before it occurred to any one that this flowing stream could act as a means of transportation for solid particles set free in its current, and that said particles could find lodgment at some point other than that of entry.

Rudolph Virchow was the first to teach that injury to a vessel wall or changes in the blood sufficient to cause clotting at some one site might be followed by dislodgment of a portion of the clot, which could be carried along in the blood stream until it reached a vessel too narrow for it to pass, and there become tightly wedged. Naturally this is bound to stop the circulation of blood through a vessel thus affected, and give rise to circulatory disturbances in the vicinity, of great or little importance, depending upon whether the vessel affected is a terminal branch.

In this chapter I shall discuss venous thrombosis after surgical operations, followed by the liberation of emboli sufficient in size or number to block completely the more important branches or a main stem of the pulmonary artery, so as in many instances to cause sudden death.

Pulmonary embolism frequently follows, and, in fact, is a natural sequence to thrombophlebitis. The factors concerned in the formation of a thrombus as mentioned elsewhere in this work are of vital importance here, since the condition is due to the whole or a portion of the blood clot becoming dislodged, and floating free in the blood stream until finally it stops when a vessel is reached too small for it to pass through. Thrombosis most commonly occurs in the pelvic veins and in those of the lower extremities following laparotomy. This fact is not surprising when it is remembered that pelvic and abdominal operations are more frequently performed than are operations on other parts of the body, and that operations anywhere, if veins are subjected to trauma or infection, are likely to be followed by this condition and by subsequent embolism.

Cases of blocking of the pulmonary artery by a mass of clot broken off from a venous thrombus are by no means uncommon. They occur most frequently between the second and fourth week after operation. The patient may die at once, there may be a more or less prolonged respiratory struggle ending in death, and in at least one instance the author has seen complete recovery. The outcome depends on whether the detached mass goes through the right heart intact in sufficient size to completely block (Fig. 46) the pulmonary artery, whether it partially blocks it, or blocks one of its main divisions and is then increased in size by other following masses or by the subsequent coagulation of blood behind the obstructing mass. Immediate death follows the complete plugging of the main trunk of the pulmonary artery. Sudden death may occur after plugging of only one of the main branches, provided the patient has not a perfect heart muscle. A perfect heart may, on the other hand, withstand the effects of a partial obstruction of this kind.

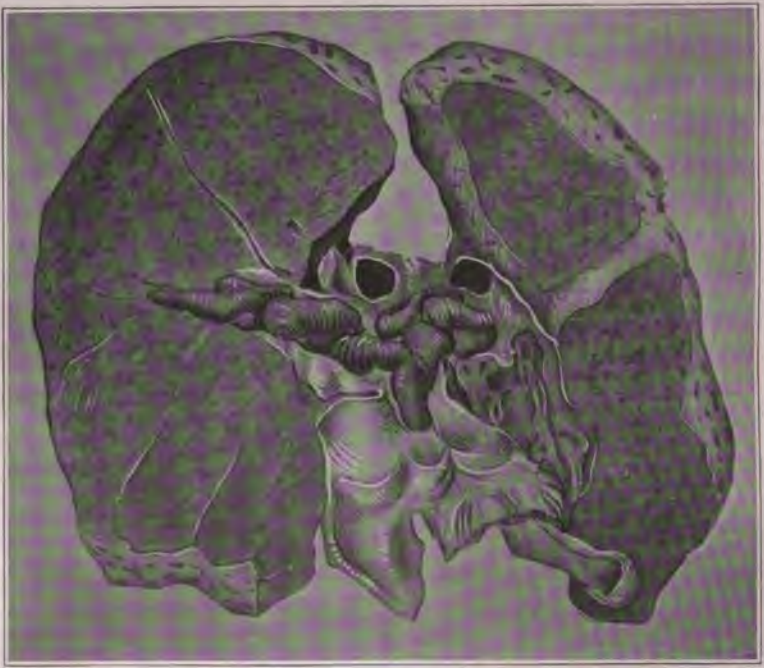

Fig. 46.—Complete blocking of pulmonary artery by embolus. (After Aschoff.)

Anatomy.—Autopsy findings in such cases are exceedingly scant, infarction of the lung being seen only where smaller branches of the pulmonary artery have been affected. Of course one can think of cases in which tiny emboli have preceded the fatal extensive plugging and thus caused limited infarcts before sudden death took place. This is, however, the exception rather than the rule, and is usually due to the fact that there is thrombosis of several small veins at the site of operation. Any of these thrombi may give rise to emboli, and a small embolus may be carried to the lung at any time from one of the thrombi, wholly independent of the large embolus which caused death.

Dr. R. L. Thompson, pathologist to the St. Louis University, who has been good enough to cooperate with me in the preparation of this chapter, states that in autopsies, in case of death from pulmonary embolism, the pulmonary artery should be examined *in situ* before the heart is removed or cut into, as the site of an embolus is usually at the point (Fig. 47) where the vessels were cut in removal of this organ. If this be not done, the embolus which may have not as yet become attached easily slips out unobserved and may be entirely overlooked by the pathologist.

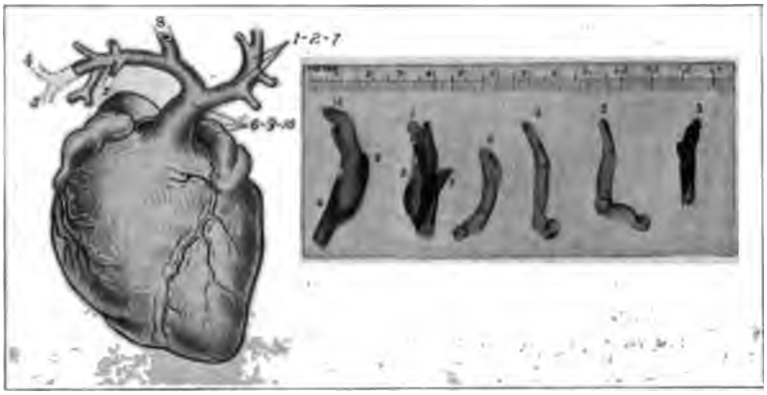

Fig. 47.—Pulmonary emboli removed at autopsy. (Mayo Clinic Collected Papers, vol. ix.)

Pathogenesis.—The origin of an embolus, while it may come from any part of the systematic venous system or from the right heart, is most frequently found in the veins of the lower extremities, in the deep epigastric and pelvic veins, or in those of the mesentery.

Albanus gives as prevailing causes for thrombosis after laparotomy, sepsis, heart imperfections, pressure of tumors on veins, cooling and handling of blood vessels while the abdomen is open, the effect of necrosis on the heart, the recumbent position and the pressure of a bandage. *He overlooks what I believe to be a most fruitful* *cause of the condition: varicosities on veins which are directly affected by the operation.*

On the operating table it is not uncommon to see greatly changed veins, carrying the blood from large tumors, and in one instance, at least, of our series No. 2, Dr. Thompson and I were able to demonstrate, both at operation and at autopsy, these varicose veins and their causal relation to fatal embolism.

I know of another instance in which varicose veins of the lower extremity were manipulated by well-intended but misdirected massage about a knee joint which had remained stiff after an operation. The result was a sudden fatal pulmonary embolism. It is quite obvious that thrombi had formed in the divided varicose veins, had been loosened by the massage and swept into the pulmonary arteries.

All lung symptoms, according to Gussenbauer, which arise after the release of incarcerated hernia are to be regarded as embolic in nature. Other surgeons go equally far in connecting this subject with abdominal surgery. It may be cited as an instance that the Mayos, when resecting the stomach, invariably cauterize the cut edges of that viscus to prevent septic pulmonary embolism, as I was long ago informed in a personal communication. Since doing this, they see pulmonic emboli following such operations much less frequently than they formerly did.

As Albanus, quoted above, states, sepsis is naturally to be thought of as a factor in these cases. Hence one is not surprised at the remark of Sonnenburg that 5 per cent of all appendix operations are attended with thrombosis somewhere in the vicinity. No doubt he refers to the acute septic variety.

As mentioned above the reason for the greater number of cases given in the literature as showing thrombi originating from the femoral, epigastric and pelvic veins, so far as the surgeon is concerned, is due to the fact that pelvic and abdominal operations are much more frequently performed than are operations in other parts of the body. Such procedures elsewhere, when veins are subject to trauma or infection, are apt to be followed by thrombosis and subsequent pulmonary embolism, as they are in the before-mentioned situations. This is well illustrated in the case of a man, seventy years of age, whose larynx had been removed for carcinoma eight days before sudden death ensued. When Dr. Thompson made the autopsy he found the pulmonary artery occluded by a partially organized blood clot 1.5 cm. in diameter. This extended into both main divisions of the artery. The lungs were edematous and congested. The right heart was distended and full of blood. The neck was much swollen. The operation wound showed some superficial necrosis, with healthy appearing granulation tissue below. On the right side *the internal jugular vein was distended to a diameter of* 3 *cm., and was occluded by a solid, grayish, granular thrombus for a distance of* 8 *cm.* It is, of course, reasonable to suppose that the mass occluding the pulmonary artery had broken off from that in the jugular.

The frequency of pulmonary embolism, including the cases of embolism of the smaller branches of the pulmonary artery that give rise to little or no permanent after-effects, is much higher than is usually supposed after surgical operations.

This malady is as frequent in one sex as in another, but does not occur before the fifteenth year, according to Petren. This author states that it is common between the ages of thirty and forty-five, but most frequent after the forty-fifth year, regardless of the patient's general condition.

Virchow found in ten cases of thrombosis of the veins of the lower extremity that six were followed by pulmonary embolism. Albanus states that 43 per cent of the cases showing thrombosis after laparotomies were followed at some time or other by pulmonary embolism. This amounted to only 2 per cent of the patients who were operated upon, since only 53 cases of thrombosis were found following 1140 laparotomies. Of these, pulmonary embolism supervened in 23 instances. Quenstedt and Leichtenstern, on the other hand, both found pulmonary embolism in 20 per cent of their thrombosis cases. Opposed to this, again, is the record of Lubarsch, who demonstrated pulmonary embolism 347 times in 584 instances of thrombosis; i. e., in 59.1 per cent of such cases. In none of these instances is it stated how frequently the embolus was of sufficient size to cause death by blocking the pulmonary artery. Such cases are not rare, and from those which have been reported a few may be cited.

Welch has collected 23 cases of venous thrombosis, in which there were at least 3 deaths due to pulmonary embolism consequent upon the malady. Mynter mentions a patient in whom sudden death was probably due to pulmonary embolism following thrombosis of the femoral vein in appendicitis. Robinson describes a typical death from pulmonary embolism seventeen days after a hysterectomy. Koenig reports a case in which the patient died from pulmonary embolism although the thrombosed vein (saphenous) had been removed for the purpose of avoiding just such an untoward outcome. In this instance the clot probably had extended into the femoral vein and was therefore not to be extirpated.

From a study of 63,000 operations performed at the Mayo Clinic, Wilson found 47 instances of fatal postoperative embolism, a percentage of .07. Over three-fourths of these fatalities were pulmonary, and occurred between the fifth and twelfth days.

From the cases that have occurred in my practice, and from several that came to autopsy at the Boston City Hospital, most of them during the service of Dr. Thompson, we append the following list:

1. Carcinoma of larynx. Death instantaneous eight days after operation. Occlusion of main stem of pulmonary artery by embolus. Thrombosis of internal jugular vein.

2. Myoma of uterus. Death sudden, thirteen days after operation. Occlusion of both branches and trunk of pulmonary artery by embolus. Thrombosis of ovarian veins.

3. Compound fracture of leg. Death eight days after injury. Main trunk and right pulmonary artery blocked by embolus. Thrombosis of right heart. Culture of heart blood sterile.

4. Appendectomy. Death eight days after operation. Complete embolism of main trunk of pulmonary artery. Pus collection at the site of the appendix.

5. Appendectomy. Death fifteen days after the operation. Occlusion of both branches of pulmonary artery by embolus. Thrombus not found.

6. Uterine myoma and gall stone disease. Six days after operation collapse with recovery. Four days later another collapse of similar nature, and in two more days, that is, two weeks after operation, pulmonary embolism with death in thirty minutes.

7. Umbilical herniotomy and Talma operation for cirrhosis of liver. Death, with typical symptoms of pulmonary embolism, eleven days after the operation. No autopsy could be obtained in this or in the succeeding cases, which occurred in private practice, hence they are submitted not as proven instances of pulmonary embolism, but as suggestive surgical cases in which a better explanation of death can not be given.

8. Hysterectomy for carcinoma of uterus. A woman, four weeks after the complete Wertheim operation, was up and preparing to leave the hospital when she suddenly dropped to the floor, gasped for breath, and was dead in thirty minutes.

9. Resection of stomach for carcinoma. Three days after the operation the patient, an elderly man, was in a semi-sitting posture, talking to his nurse, having taken liquid nourishment and being entirely without abdominal symptoms, when suddenly he became un-

able to get his breath, dropped back deeply cyanosed, and died in a few minutes.

10. Hysterectomy for carcinoma. Ten days after the complete Wertheim operation this lady was sitting up in bed, having just partaken of a light lunch and being without abdominal symptoms, when suddenly she began to breathe with difficulty, extremities became cold, every evidence of extreme shock appeared, and in 11 hours she was dead.

11. Umbilical herniotomy. Eight days after this operation on a lady fifty-two years of age, there was a sudden onset of the typical symptoms which have characterized the cases just related. However, under stimulation treatment the patient gradually began to breathe more easily, and in twenty-four hours seemed out of immediate danger. She continued to improve, left the hospital a month later, and has remained well for several years.

12. Appendectomy. This was an interval operation, being extremely difficult on account of location of the appendix and adhesion surrounding it. There were no symptoms up to the ninth day, when patient got up for the first time, suddenly manifested intense cyanosis and breathlessness, became unconscious and was dead in a few minutes.

13. Intestinal resection. Two days after operation on this man of fifty-four, in whom no postoperative symptoms had appeared, he was conversing with me when suddenly he gasped for breath, became blue, then unconscious, and was dead in five minutes. A knife which happened to be handy, was plunged into his trachea and artificial respiration maintained for a protracted period. The fact that this measure was without avail seems proof of the fact that this suffocation can be regarded only as having been due to the sudden interruption of the oxygen-carrying blood stream.

14. Operation for varicose veins of leg. A lady forty-seven years of age had experienced the combined Mayo vein stripping and the Schede ligation on the lower extremity. The evening following the operation she suddenly experienced all the typical symptoms of pulmonary embolism, which then rapidly disappeared; she then made a protracted, but otherwise uneventful recovery. It seemed probable to the experienced clinicians who saw her that this was, in view of the nature of the operation, in great probability a case of pulmonary embolism.

Symptoms.—It may be of value in these 14 surgical cases to note the interval of time that elapsed after the operation or injury before the onset of pulmonary symptoms. In these instances this period was as follows: 1, one day; 1, two days; 1, three days; 1, six days; 4, eight days; 2, nine days; 1, eleven days; 1, thirteen days; 1, fifteen days; 1 twenty-eight days. An average shows that a little less than seven days intervened as a rule between the time of operation or injury and the lodgment of the blood clot in the pulmonary artery. It should be noted that in those cases where embolism occurred a few days after operation, the condition was such that thrombosis may have been present some time before it was performed.

Twelve of the 14 cases resulted fatally. In this connection it is interesting to note the time intervening between the onset of symptoms and the occurrence of death in these and in six other cases known to me. This is given in each instance as found in the hospital records: 3 suddenly or instantly; 1 almost instantly; 1 in a few minutes; 3, five minutes; 2, ten minutes; 1, fifteen minutes; 4, thirty minutes; 1, two hours; 1, five hours; 1, eleven hours; and 2, twelve hours.

So far as the symptoms of thrombosis preceding pulmonary embolism are concerned, Lotheisen has very properly remarked that they very often fail entirely. Schachtler, however, has made some very interesting observations which may be of value in this connection. He had the opportunity of studying seven cases at Zurich, and noticed that the temperature remained normal in all of them, while the pulse gradually rose in a step-like manner until the lung symptoms became manifest. He refers to this change in the pulse as a prodromal symptom indicative of thrombus formation.

The symptoms of pulmonary embolism itself can not fail to be burned into the memory of one who has ever seen a patient die as a result of this accident. A seemingly normal individual suddenly becomes breathless, cyanotic, anxious, restless, complains of pain and oppression in the chest, the pupils grow wide, cold sweat pours out and unconsciousness quickly supervenes. The pulse in many instances becomes rapid and irregular to the point where it can not be counted at all. In one case which we have mentioned we had apparent complete blocking of the main trunk where symptoms of complete suffocation suddenly appeared. The pulse, as might always be expected when air is instantly cut off, became slower and less compressible, the symptoms in general being analogous to those when one of the main branches of the pulmonary artery is ligated in a dog. The rapid overdistension of the right ventricle which ensues is accompanied by a lowering of arterial blood pressure and by a tremendous rise of venous pressure. This, of course, follows the initial rise in arterial pressure. Whether cyanosis, dyspnea, and failing pulse are referable to cerebral anemia or to interference with coronary circulation, or to both together, is, according to Welch, neither easy nor important to determine.

Treatment.—Unfortunately the treatment of such conditions must be largely of a preventive nature. In order to prevent just such accidents, Mueller cites cases in which he ligated quite a number of varicose veins of the lower extremity, while Kramer split varicose saphenous veins in 50 instances and evacuated thrombi to prevent pulmonary embolism, as well as to combat the local effects of the disease. He states that he was successful in every instance. Becker advises the removal of the saphenous vein when the thrombus has not extended into the femoral.

It is perfectly obvious that superficial varicose areas should be subjected to no manipulation during the postoperative convalescence. One might go farther, indeed, and urge that they be kept carefully protected in order to avoid the misfortune which attended the knee joint massage alluded to above. My own suggestion, prompted by more than one of the cases above recorded, relates to *varicose veins in the vicinity of abdominal tumors.* Not infrequently are these seen in the female pelvis, especially in connection with myomata of the uterus. They should, if possible, be *extirpated with the growth, or at least ligated as far out as possible toward the pelvic wall,* to avoid the likelihood of thrombosis (should they be left behind) with a subsequent fatal accident of the most distressing nature.

Given a patient in whom unduly large diseased veins have been found at operation, and who hence is supposed to present a predisposition to embolism, it is not going too far to urge that such an one should not be allowed any undue exertion for at least a week. There should, as a matter of course, be the least possible increase in the abdominal tension necessary to empty the intestinal tract, the genito-urinary tract, and the respiratory apparatus, while the patient should be warned against sudden violent movements of any kind through nervous unrest.

Some authors advise that the patient be got out of bed *early*, that the bowels be kept open, that respiratory exercises be indulged in, and that preliminary heart stimulation be undertaken.

So much for prevention. Should the accident happen, a very strong heart may tide over an individual in whom only one branch of the artery is occluded, and consequently the opinion is general that every heart should be aided as much as possible by stimulation. However, not much is to be expected in many instances.

The patient must be elevated so that respiration be favored, plenty of fresh air or even oxygen should be exhibited, and artificial respiration has been suggested. (One fails to see, however, the logic of this latter.) The patient is to be encouraged, reassured, and if possible kept from the panic which rapidly wears out an overdistended, overworked and dilating heart. Atropine has been suggested. Counterirritation by rubbing over the posterior pulmonary area may have some effect in keeping down pulmonary edema. Osler injects camphor oil and ether every half hour, then follows this with atropine. If the patient lives three hours, he states that stimulation with strophanthus, or other similar drugs, may be indulged in. The calcium salts and other substances intended to increase the coagulability of the blood are of course to be avoided. Bidwell has warned against magnesium carbonate, milk, etc., for this reason.

Trendelenburg's experiment of removing a pulmonary thrombus from the living human subject is too well known to deserve more than passing mention here. In describing the technic in his "Technik der Thoraxchirurgie," Sauerbruch writes that not one of the several upon whom it was done at Leipzig lived. Still he thinks such a desirable outcome possible in the future.

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CHAPTER XXXIX

PYLEPHLEBITIS

By O. F. McKittrick, St. Louis, Mo.

The significance of thrombosis and embolism in other parts of the body depends entirely upon the location and extent of the affection.

Pylephlebitis: Inflammation of the portal vein, with subsequent abscess formation of the liver while not a frequent occurrence following operations, too often complicates a surgical convalescence, particularly one in which the appendix and rectum have been involved, to receive other than careful attention. Probably the first case recorded in literature, according to Loison,[1] was described by Waller in 1846. A short time thereafter Hilliaret reported an ascending infection of the hepatic veins from an ileocecal abscess, and from this same source infection of the liver occurred in a case reported by Buhl in 1854. Of late years Gerster[2] and Munro[3] each reported 9 cases following appendicitis, while Hart[4] collected 17 cases of liver abscess due to pylephlebitis, 3 of which were attributed to affections of the appendix. Beer,[5] adds another case to the list as a consequence of gangrenous appendicitis. Enderlen[6] collected 6 cases of thrombosis of the portal vein as a result of blunt force being applied to the abdomen, and in addition, described one of his own.

The condition most frequently follows appendicitis, but it may occur after other operations especially those about the rectum in the presence of infected hemorrhoids. The origin of this dire malady occurring after appendectomies or hemorrhoidal operations is not so surprising when it is considered that thrombosis of the veins in these regions (Fig. 48A) is a part of the inflammatory process; and when a portion of a thrombus is dislodged it has a direct course to the portal system (Fig. 48B), through the appendiceal veins emptying into the superior mesenteric, in the former case; and through the superior hemorrhoidal, the inferior mesenteric, the splenic, and the portal vein in the latter case. However, it does seem strange that it should occur just as often in clean and simple cases as in those of the most virulent type.[7] It also matters very little whether the operation is performed during an acute attack, in the interval, or in the presence of abscess formation.

The original thrombus is usually located in the lower part of the portal vein, though thrombi may be scattered along the whole

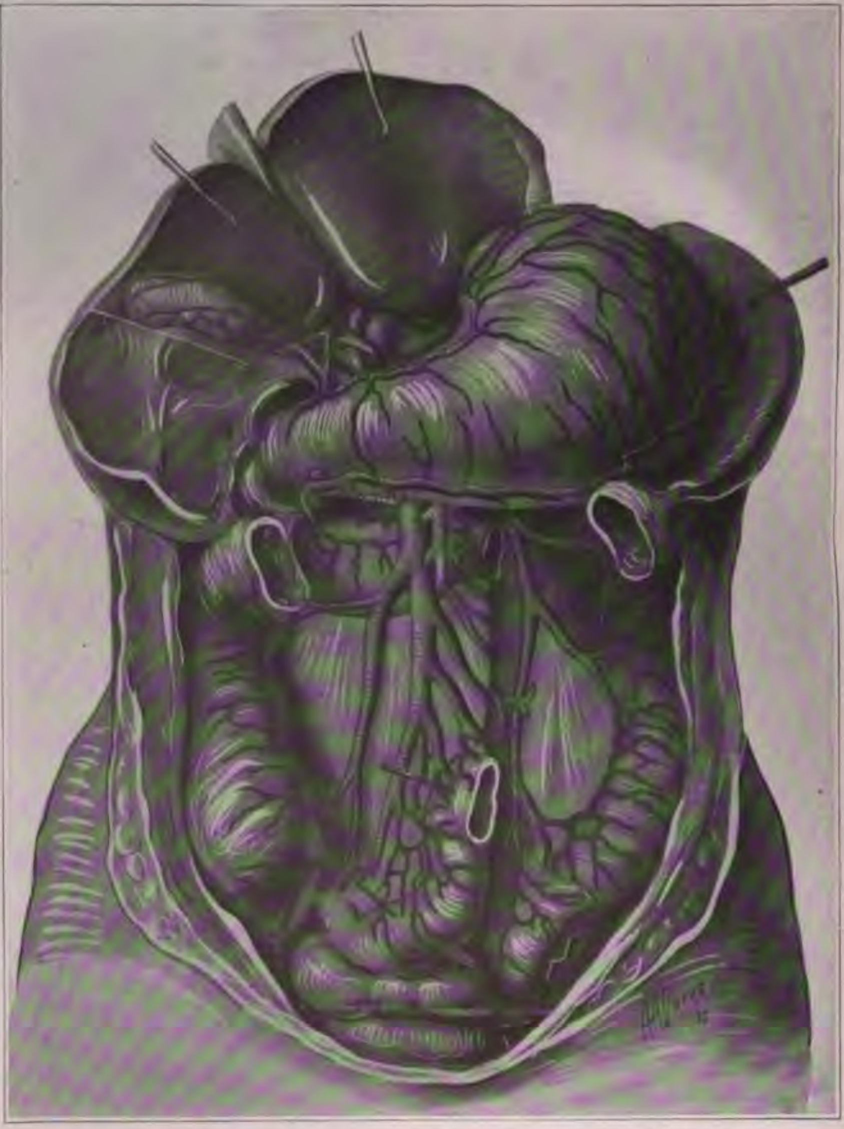

Fig. 48-A.—The many tributaries of the portal vein. (After Spalteholz.)

course of the vessels to the primary point of inflammation. Emboli originating from these thrombi pass further along the course of the vessel and lodging in its finer branches form secondary abscesses throughout the liver. Unfortunately, these abscesses are multiple and seem to show a preference for the anterior surface of the liver.

Pylephlebitis, as stated elsewhere, is ushered in with chills followed by high fever and pain which is usually severe, and more or less generalized over the right hypochondrium. Soon thereafter the patient may become icteric. In Beer's case all of these symptoms appeared within 24 hours after the operation. The blood culture taken at the beginning of the symptoms showed streptococci; while the leucocytes were 18,000, the polynuclears being 94 per cent. The physical examination in most of these cases will reveal pain and tenderness along the right border of the right rectus muscle and a tender, uniformly enlarged liver and spleen. The course of the disease is usually very rapid; but if life is prolonged a few days, the patient will show marked emaciation.

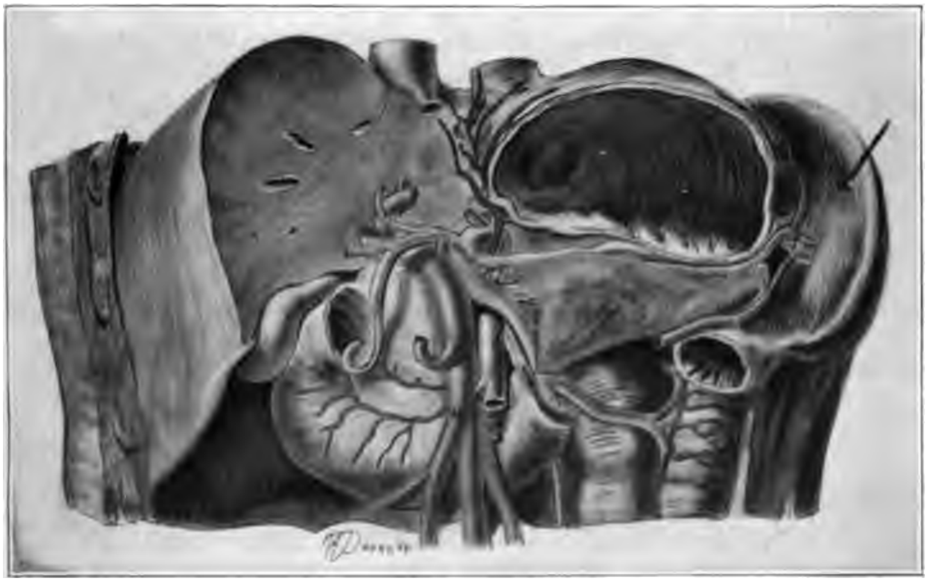

Fig. 48-B —The portal vein. (After Spalteholz.)

Treatment.—The only possible treatment is surgical. There are no preventive measures, unless the admonition of Gerster[8] is observed that undue traumatism to the tissues during operation be avoided. Prompt surgical interference in cases of appendicitis or infected hemorrhoids may be a step toward diminishng the instance of this disease.

As yet no definite surgical procedure has developed for this condition. For more than half a century men have experimented in an effort to find a method of treatment which would effectually combat the ravages of these infections. Ore[9] in 1856 ligated the portal vein in rabbits resulting in death of the animals in a very short time. Later on Schiff,[10] Claude Bernard,[11] and others showed very conclusively that portal vein ligation in dogs caused death within three hours. Kusnetzow[12] thought that ligation of the vein at a level other than the ones which had been employed before might prove compatible with life. His idea was soon borne out by his experiment showing that dogs may live if the portal vein is occluded above the gastrosplenic. His work unfortunately could not be confirmed by others including Ito and Omi,[13] and Neuhof.[14] It never occurred to any one that the portal vein could be occluded by ligating its branches at different times without producing death of the animal, until Solowieff[15] appeared upon the scene. His work has been shown to be correct by Neuhof. The latter ligated the inferior mesenteric, superior mesenteric, splenic, and finally the portal veins in each animal during different operations, and found that the dogs in every instance lived and enjoyed good health. The animals sacrificed and examined showed in each case a well-developed collateral circulation coursing within the gastrohepatic omentum from the region of the stomach to that of the attachment to the liver. The liver was found to be normal in every way after the final ligation of the portal vein.

Other experiments were carried out by Neuhof in which he gradually occluded the portal vein itself, a number of operations extending over several days in each case being done, and found that his results were in accord with those above.

The outcome of these experiments is not astounding since it has been known for some time that the portal vein may become occluded in the human being without subsequent death. In fact, Bartlett packed it full of gauze after accidental injury during a common duct operation, no ill-effect being observed in consequence. Gintrac[16] in 1857 collected 6 cases of portal occlusion in the human subject, and since this time many cases have been placed on record. Some of the patients lived as long as thirty years. The resulting anastomotic circle caused by the cessation of blood flow through the portal vein was considered, and rightly so, the same as in cases of cirrhosis of the liver, but in addition, Pick[17] has recently shown that the newly formed gastrohepatic anastomosis is very efficient in carrying blood to the liver. Umber[18] reported a case in which the adhesions, following portal vein occlusion, carried vessels which took the place of the regular gastrohepatic anastomosis.

By experimentation then, it has been shown that the portal vein can be ligated without ill results to the subject, and that a collateral circulation rapidly develops in the gastrohepatic omentum. Therefore, Neuhof strongly recommended this procedure in suppurative pylephlebitis, and in view of the fact that the condition almost invariably ends fatally it seems to us justifiable to use any procedure which offers any measure of hope. While some of the cases run a very rapid course, some patients live weeks and even months.[14] In the latter cases the postmortem has shown collateral circulation to have been established with the portal vein completely occluded. Multiple abscesses inevitably follow such a condition and this is another reason for ligation, since such a procedure will cut off the source of the hepatic infection.

The technic of the operation as done by Neuhof is briefly as follows: A curved incision starting near the lower end of the sternum, running parallel with the right free border of the ribs descends vertically for 5 cm. The upper part of the right rectus muscle is then divided transversely. The margin of the liver is elevated, and the pyloric end of the stomach drawn downwards. The region of the portal vein is thereby brought into view, no further dissection being necessary. The vein itself is sufficiently exposed by incising the thin layer of overlying peritoneum. It can now be gently freed from the surrounding structures and readily ligated above the entrance of the gastrosplenic vein.

In cases where operation is decided upon very soon after the occurrence of this complication, the vein should be gradually occluded. Whether this is to be done by ligation of the branches as above mentioned or by gradual compression of the vein itself by means of a clamp, must be determined by the surgeon himself. On the other hand if there is reason to believe that time has elapsed sufficient to bring about collateral anastomosis, the vein should be immediately ligated. As to the point of election Neuhof would ligate above the highest portion involved if this was surgically accessible. In every instance surgical occlusion of the portal vein should be combined with an omentopexy in order to assist the already forming collateral circulation. According to Gerster[19] the pus in the vein may be drained if the blood stream has been sufficiently side-tracked.

In the case reported by Beer an omentopexy was done three days after the symptoms of pylephlebitis had developed. Neither the two mesenteric nor the splenic veins being easily accessible, ligation was not attempted. After three days the portal vein was ligated. The patient died within forty-eight hours, but death was apparently due to a septicemia, streptococci and colon bacilli being the infective agents. No signs or symptoms referable to occlusion of the portal system were in evidence following the operation.

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CHAPTER XL

SKIN ERUPTIONS

By O. F. McKittrick, St. Louis, Mo.

Cutaneous eruptions at times follow surgical operations. The surgical interference may be the direct cause of these eruptions but usually other factors which present themselves during the convalescence are responsible. Recently McCarty[1] has observed that out of every 1000 consecutive operative cases, 43 showed some sort of skin disturbance. He found that the lesions were of two types, the first appearing within 24 to 48 hours after the operation and the second appearing after a longer period.

"The earlier cases were characterized by a mild erythematous or papular eruption of general distribution, with no systemic disturbance and little elevation of temperature. Itching was marked from the beginning and the face was involved in every instance.

"In the other class of cases the eruption appeared suddenly three or more days after operation. During the interval there was no prodroma, but the temperature continued higher than in normal convalescence and the blood showed a moderate leucocytosis. The condition varied from a localized to an almost continuous eruption and in some cases at first resembled scarlet fever or measles. It began as an erythematous or fine papular eruption located at first on the inner surfaces of the forearms and thighs and extending over the whole body, rarely affecting the face and never involving the palms and soles. It was accompanied with marked itching which persisted until fading occurred. The papules were at first pink and later dark red with a tendency toward coalescence over the bony parts, and the eruption reached its height in 24 to 36 hours, after which it began to subside. The onset occurred as late as 7 days after the operation and the condition persisted from one to seven days. Desquamation was not observed in any case.

"The temperature showed an elevation of about one-half degree above that of a normal convalescence and this elevation continued until the eruption had disappeared. The daily leucocyte count was 14,000 until the eruption had faded."

In all the cases in his series, ether was the anesthetic employed, but cases have been reported by others where nitrous oxide and chloroform have been used. Catharsis, enemata, or drugs seemed to have no influence and there was no definite relation to menstruation.

The condition seems to be due to a combination of factors, there being in each case an immediate cause, a certain individual idiosyncrasy and an underlying nervous susceptibility.

The immediate cause takes the form of mechanical irritation, such as operative shock, enemata, or drugs, and the underlying cause acts probably as a vasomotor disturbance due to irritation of sympathetic nerve fibers.

Ether Rash.—During etherization, Probyn and Williams[2] have stated that a rash may occur, especially in women and children, which usually appears just as the patient is becoming comatose and takes the form of an erythema which occurs most frequently on the neck and shoulders, but the chest, abdomen, and even the thighs may become involved. Profuse sweating frequently accompanies the rash and lasts about ten minutes. Buxton[3] and others state this phenomena is due to the action of the ether on the central nervous system.

Septic Rash.—At times there appears a general erythema resembling that of scarlet fever, or the skin complication may take the form of an urticaria and become pustular or hemorrhagic, followed in a few days by desquamation. It may be associated with septicemia and pyemia, or occur within the course of a few hours following the symptoms of such general infections. Frequently in children an erythema occurs in the upper half of the body in conjunction with suppuration. It is usually ushered in by a few hours of malaise, restlessness, high temperature, and fast pulse. Frequently a leucocytosis is present. Within 4 or 5 days the eruption fades and unless it has been very severe no desquamation follows.

There is described by several writers a condition known as erythema scarlatiniforme which occurs after operations. This condition which was first described by Hardy is characterized by lesions which vary from a localized erythema, to a general scarlatinous eruption. The symptoms range from none at all to the most severe grade of constitutional disturbance. With the appearance of the skin lesions the constitutional symptoms usually subside and within one to four days the eruption begins to abate and a fine, almost imperceptible desquamation follows. The whole process takes from about ten days to four weeks.

The *treatment* in these cases concerns itself with elimination. The case should always be isolated, but not exposed to other infectious diseases. Most authors advise a zinc oxide and starch powder to be applied: other palliative measures are carried out to relieve any discomfort.

True scarlet fever has been reported too often not to mention it a serious complication in these cases. Recently Roberts[4] reported four cases in which the diagnosis was made by many men skilled in this particular disease which makes the fact all the more interesting. Many observers believe this communicable condition is a mere coincidence, while others think it is due to the increased susceptibility caused by the shock of the operation, by the wound, or burn, etc. The malady occurs most frequently in children. The eruption is usually typical and is followed by desquamation. It is not at all unlikely that in patients who have had recurrent attacks of appendicitis for instance, the presence of an undetected scarlet fever in its incubation stage may stir up acute appendiceal symptoms and cause the surgeon to operate. The eruption appearing in a day or so later would then be considered a surgical scarlet fever. The treatment of scarlet fever under such circumstances is that ordinarily described in textbooks on medicine.

A condition that is frequently seen follows surgical procedures under unclean conditions; such as incisions for drainage of pus wherever located, around abdominal drainage, tubes, infected wounds, etc. It is called infectious eczematoid dermatitis and is due to infection of the skin follicles by the pus organisms. It begins insidiously around the edges of wounds and may spread over very large areas and even involve parts of the skin at a distance. The characteristic lesions are tiny follicular pustules which quickly aggregate to form patches. There is considerable itching, and secondary lesions due to scratching quickly make their appearance.

The treatment is the use of mild antiseptics in ointment form. Three per cent xeroform in petrolatum is a very good application. One per cent ammoniated mercury ointment or two to four per cent ichthyol are also efficacious agents. The condition is sometimes very severe, covers very large areas of the skin, and is highly resistant to treatment. Under such circumstances the use of staphylococcus vaccine will produce good results.

Food as an etiologic factor in producing skin lesions, such as erythema and urticaria is well known. In many instances they are apparently produced by so-called indigestion,[5] but idiosyncrasy perhaps plays an important role. Inability to digest the starchy foods is noted in some of these cases.

An improper diet,[6] either too much or too little food, can be considered a factor in many skin lesions but whether it acts directly or indirectly has not been determined. Eruptions following the ingestion of strawberries, buckwheat, and oatmeal have been noted. Particularly have they been seen after the ingestion of foods and condiments which are difficult of digestion or are too stimulating such as pastries, cheese, veal, spices, mustard, pepper and pickles. Foods which easily undergo decomposition, such as pork, oysters, lobsters, fish, crabs and clams, are always to be considered as possible causes.

While such food is not allowed in the early postoperative treatment and therefore does not enter as a factor, later on in the convalescence it becomes a very important question and a knowledge of the baneful influences of such foods will often prevent an unpleasant complication.

A toxic erythematous rash other than that produced by food has been noted following sudden changes in the weather, in cases where the patient was exposed to cold or to a chilling wind. Absorption of secretion and of aseptic material from wounds is followed by toxic rashes at times. The eruption appears without prodromal symptoms within 48 hours after the exposure or operation. It occurs in patches and usually involves only the body and extremities and disappears in about 24 hours. In children, however, there may be a marked febrile reaction with gastric symptoms, delirium, and even coma. Crawford,[7] Shepherd[8] and others have noted such a condition following soapsuds enemas, in which the ordinary yellow soap was used. Shepherd was able to diminish the eruptions in his patients by using castile soap instead. He concluded the resin in the soap produced the skin lesions. Other observers think the irritation alone is the causative factor as the eruptions occur following enemas of any kind.

The *treatment* is directed above the line of relieving the cause and is chiefly palliative.

Drugs have long been known to produce various kinds of skin eruptions. The symptoms produced by medicinal agents constitute the symptomatology of the various erythematous, exudative, and inflammatory diseases.[9] The eruptions may occur somewhat suddenly following a dose or so of the drug, and again the lesions may occur only after continued use of the inciting medicinal agent. At times the eruption does not occur until after the drug has been withdrawn. Usually a withdrawal of it prevents a continuance of the symptoms, though, as in the case of bromides and iodides, particularly in children, the lesions may be present for some time.

According to most observers the eruption in the majority of cases is due to an idiosyncrasy of the patient to that particular drug. The same type of lesion is usually produced in the same patient though this does not always follow. Women and children are most frequently affected and it seems that blondes are more susceptible than brunettes.

Just how drug eruptions are produced has been the object of much investigation. The theory that the drug causes the irritation as it is being eliminated by the skin has been proved untrue. Behrend believes that the drug generates some toxin in the blood to which the eruptive condition is due. Engman and Mook[10] do not directly support such a view, but partially confirm the hypothesis. Investigations have shown that in skin lesions caused by iodides and bromides especially, the drug circulates in the blood and under certain conditions, acts as a toxin. The chief change which it produces in the skin is a slight deposit of cellular elements about the blood vessels. This is best seen in the apparently normal skin and in the absence of gross lesions. It has also been noted that the worst lesions are seen in those patients who present heart or kidney disease or both. Morrow[11] thinks the lesions are the result of the action of the drug upon the vasomotor centers or upon the peripheral nerves.

Of the innumerable drugs which produce various skin lesions only a few of the common ones used in a surgical convalescence will be named.

An erythematous or erythematopapular eruption is caused by acetanilid, antipyrin, aspirin, benzoic acid, digitalis, iodine compounds, phenacetin, belladonna, sulphonal, veronal, potassium chlorate, mercury, and morphine.

Papular or pustular eruptions are produced by the salicylates, mercury, opium, iodine and bromine compounds.

When drugs which are known to cause skin lesions are given and one develops, coming on suddenly without prodromal symptoms and in the absence of fever, the drug must be stopped at once. These lesions may be distinguished from the acute exanthemata by their symmetry and also because they appear both on the exposed as well as the unprotected surfaces of the body.

Failure to recognize the deleterious effects of drugs may end in serious poisoning which can cost the patient his life.

Poisoning from local antiseptics is not rare. An erythematous eruption is usually produced by these agents. The lesion is usually bright red in color and itches intensely. The condition is relieved by discontinuing the antiseptic, and the skin protected by some bland ointment, as boric or zinc oxide. Here should be mentioned the dermatitis following the application of iodine tincture which is quite frequently seen. Treat by starch solutions.

The extensive application of iodoform to an absorbing surface or extensive packing with iodoform gauze may cause poisoning. In such cases there is a general feeling of malaise, nausea, and the perception of odors which in reality are not present. Headache and vomiting may occur. If the poisoning is severe enough there will be cerebral excitement, loss of memory and loss of appetite and a rapid pulse. Grave convulsive movements and maniacal delirium may alternate with coma, in which the patient may die, the heart and respirations ceasing simultaneously.

The *treatment* is to get all the alkalies and water possible into the system by mouth, proctoclysis and hypodermoclysis. Sodium bicarbonate according to Sonillier will unite with the iodine and hence this form of alkali should be used. Dry-cupping the body over the kidney region and wrapping the patient in blankets, will rapidly eliminate that which is not excreted by the kidneys. In the meantime the system must be supported by alcohol or other stimulating drugs.

In addition to the local effect, extending even to gangrene, systemic poisoning from carbolic acid has occurred from too free use over raw surfaces, though the fatalities are now rare indeed. However, many cases are on record in which subacute phenol poisoning has been produced by its absorption from surgical dressings. The earliest signs of this accident are darkened smoky urine, and slight nervous unrest or cerebral disturbances. There may be pain in the kidney regions. The poisoning being severe enough, the patient becomes drowsy, pallid, has more or less intestinal symptoms, and the respirations grow labored, stertorous, and coma may develop.

In the treatment of this condition first remove the cause, wash the stomach, and administer large doses of Epsom salts. Further treatment consists in keeping the extremities warm and the administration of respiratory and cardiac stimulants. Morphine may be required to relieve the pain. All the measures for elimination should be employed. At the same time as the skin symptoms, general ones of bichloride poisoning may occur after absorption from a wound from a serous surface, or from a mucous membrane. Usually the poisoning is not of such severity as to produce symptoms other than ptyalism and diarrhea; but in the most severe forms there appear cramps in the limbs and abdomen in addition to the above, feeble pulse, cold skin, extreme restlessness, even collapse and death.

Recently Foskett[12] reported a fatal case of mercurial poisoning following a vaginal douche in which three 7.3-gram tablets were used in a cup of water. The patient lived twelve days following the application of this drug.

When poisoning occurs, remove the cause if possible, and at once clear the stomach by means of the tube. Administer at once through it tannic acid, eggs, milk or other albuminous substances. Such treatment precipitates the metal and protects the mucous membrane. The salivation and stomatitis which usually follow such poisoning are treated by use of potassium chlorate as a mouth wash, particular attention being given the teeth. The diarrhea is controlled with opium; paregoric should be given in dram doses every hour until the symptoms cease. Water is given by mouth and rectum followed by free diaphoresis and diuresis.

Erysipelas seldom complicates clean operations, but may follow a surgical procedure in an unclean field, it may form an extension of the same or appear on a distant portion of the body. It usually occurs in those patients whose resistance has been lowered by exposure, alcohol, old age or general debility. The disease is an acute, contagious and very rapidly spreading lymphangitis which is caused by the streptococcus pyogenes growing and proliferating in the small lymph channels of the skin and subcutaneous tissue and even in the lymph channels of the serous and mucous membranes. Though the disease is contagious, Panton and Adams[13] have definitely shown that it is seldom conveyed from one patient to another. Of the various forms of this disease the erysipelas simplex is the most common of the cutaneous types, which occurs most often following surgical interference.

The symptoms of erysipelas are varied. In cases of moderate severity the condition is usually preceded for several hours to one or two days by prodromal symptoms of constitutional disturbance such as malaise, chilliness, nausea, and vomiting. The temperature goes at once to 102° or more and after a decided rigor, and feeling of chilliness, the eruption sooner or later appears about the wound. There will be a burning and itching here, and upon examination the elevated tender and reddened lesions with sharply defined borders will be seen. The inflammation spreads, the borders being acutely inflamed and sinuous in outline. Later, the center, or origin of the infection, the color and tenderness tend to disappear. The temperature remains high, and the patient is prostrated. After a few days to many weeks the process begins to subside, the swelling becomes less and the color fades into a brown and later a yellowish white. The blebs which probably formed, now dry up and desquamation takes place. The constitutional symptoms abate and the patient passes out of danger. In the old and in infants the mortality is nearly 50 per cent. The general mortality is not much under 10 per cent. The disease is particularly dangerous in that gangrene may supervene or cellulitis or other metastatic infections may occur. Secondary complications like nephritis or pneumonia often carry the patient off. Recurrence takes place in a few cases.

The *treatment* of this condition is not very satisfactory. The patient should be isolated, the diet should be light, given in small quantities every three or four hours. Fluids should be pushed and every effort made to prevent an acidosis. The eliminative treatment must be thorough. The heart must be watched closely and stimulants given whenever there is need for them. Some tonic which contains iron and quinine is useful. For sleeplessness or delirium, chloral, bromides or opium should be used.

The wound is kept clean, open, and a wet pack of Epsom salts applied. This quickly allays the burning and assists nature in draining out the infectious material. Around the wound alcohol and iodine half and half may be painted. In all cases the original wound must be thoroughly drained and no agent applied which would in any way hinder the drainage. Ichthyol 10-25 per cent has been very commonly used though it is hard to say how much good it and other applications do, in view of the fact that the disease tends strongly to spontaneous recovery. The most modern treatment consists in exposing the affected area to the sun's rays or to those of an incandescent bulb, since both have an undoubted germicidal influence.

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CHAPTER XLI

HEMOPHILIA AND OTHER HEMORRHAGIC DISEASES

By O. F. McKittrick, St. Louis, Mo.

The control of hemorrhage is naturally of paramount importance in operative patients. Usually, very little trouble is experienced in bringing this about, but occasionally patients are operated on account of the urgency of surgical condition, without the surgeon knowing that they suffer from some constitutional malady which makes hemostasis difficult or even impossible. Of the diseases which predispose to hemorrhage apparently through delayed clotting of the blood, hemophilia stands out in bold relief. This disease was first investigated by Nasse in 1820. It fulfills a law, known by this investigator's name which implies that the affliction is limited to males, being transmitted from one generation to another through unaffected females. It is an hereditary malady, clinically characterized by great delay in clotting of the blood, following traumatic hemorrhages. Other members included in the family of hemorrhagic diseases, which differ widely in their pathologic conditions, but present hemorrhage as a common symptom, are the various purpuras, hemorrhagic diseases of the newborn, jaundice, the grave anemias, and other conditions associated with infections or chronic ailments. The purpuras are probably the most important class of diseases, next to hemophilia with which we have to deal. In purpura, the hemorrhages are spontaneous, small petechia appearing in the skin in various portions of the body. The blood clots within nearly the normal[1] time, though the platelets are diminished, which in hemophilia are normal. Like hemophilia, however, purpura may be a family disease. Any doubt arising as to the identity of one or the other may be quickly cleared up through subjecting the blood vessel walls to increased pressure by means of a tourniquet. Hemorrhages will occur in the skin of patients suffering with any hemorrhagic diathesis.[2] These fail to appear in hemophilia.

After considerable study of the hemophilic tendency in families, Addis concluded that clinically, the cases fall into three groups;[3] in the first appear those cases which are scarcely ever free at any time from some sign of the disease, though no trauma was suffered greater than those which come in everyday events. In the second group trivial accidents alone do not lead to prolonged hemorrhage. In the third group, injuries which were out of the ordinary were followed by continued hemorrhage. Addis further stated that the only practical difference between patients of this group and ordinary individuals was that hemorrhage persisted longer in the hemophiliacs. Sajous[4] adds that the families are often large and the blondes are particularly affected. He states that it is more common in Germany and among the Jewish people but that it is encountered in all civilized countries and especially in the United States. It is interesting to note that the disease may not only complicate a surgical convalescence but also that it may be the cause of the operative interference. Schwartz[5] recently reported sanguineous infiltrations in the iliac fossa, and especially in the rectus sheath, which led to appendiceal symptoms and subsequent operation.

Hemorrhages may occur in the joints, producing swelling, pain, and fever, following some slight exertion. Hemotomata may appear in various regions of the body due to trauma which may have been so slight that the patient failed to recall it. Such tumors arising within the psoas muscle or other obscure regions, may simulate other conditions which are urgently operative, the true nature of the disease not being manifest until the blood tumor is discovered.

The hemorrhagic diseases have not as yet been satisfactorily classified since the causes of the conditions are not known, and even in hemophilia, which disease has been more thoroughly studied than the rest, Morawitz and Lossen are contented to say that "we have to deal with an inherited chemical degeneration of the protoplasm of the formed elements of the blood and perhaps of the whole organism."[6]

The coagulation of the normal blood is explained by many different theories, probably the most dependable one being that of Morawitz, and one which is supported by Wright, that in normal individuals, the blood clot is formed in the following manner: thrombokinase in the presence of calcium salts converts thrombogen into thrombin and this converts fribrinogen into fibrin, which is the essential feature of the blood clot. The enzyme thrombokinase is not present in the circulating blood but is formed through the breaking up of the leucocytes during hemorrhage and from the injured cells in the wound. Fibrinogen, thrombogen and calcium are present in the circulating blood. The existence of the fibrin ferment, fibrinogen in the blood has been definitely demonstrated. It is a protein body which forms .22 per cent to .4 per cent of the plasma.[7] The thrombogen has never been isolated though it is *believed* to occur in the circulating blood. The thrombin appears only after the blood is shed, hence it seems reasonable to suppose that its constituent elements must have existed in the circulating blood, and are therefore termed thrombogen. Thrombin has been thoroughly studied by Howell. The presence of calcium in this medium has long been known. The existence, however, of fibrinogen, thrombin, fibrin, and calcium is definitely proved. Thrombokinase and thrombogen occur only in theory. Just how thrombin is formed is still a matter of controversy; even the mode of action of thrombin on fibrinogen is not understood. Whether it is a ferment action, a chemical or a physicochemical action is still a question.[8]

It naturally follows that an abnormal clotting of the blood could hardly be explained if the normal mechanism is not understood. However, many theories have been advanced to explain the phenomenon. Morawitz and Lossen say the delay in the coagulation time is due principally to insufficient formations of the fibrin ferment factors, especially the thrombokinase. The same view was held three years before by Sahli[9] who stated that he could not tell which of the cellular elements of the blood was lacking but he considered the thrombokinase was not available in normal amounts. Addis[10] reported in 1910, 12 cases of hemophilia in which the pathology had been studied. The coagulation time in all was from one to two hours, and the only constant factor present so far as pathology goes, was the delay in the coagulation of the blood. He thinks this is due to the slow action of the thrombogen in changing into thrombin even in the presence of normal amounts of thrombokinase and calcium salts. In his opinion, hemophilia is probably due either to an absence of, or to too small amounts of, or to some change in the thrombogen. Howell also considers the thrombogen at fault. Wright[11] considered delay in coagulation time was due to lack of calcium. Kahn[12] studying two hemophiliacs, one an hereditary "bleeder" and one who had no such history but was considered a sporadic type of this disease, by metabolism studies showed the calcium content of the blood normal in the typical hemophiliac while in the atypical case, it was decreased. Administration of calcium diminished the coagulation time in the atypical, while it even increased it in the true hemophiliac. There was no derangement in metabolism as measured by the intake and output of nitrogen, sulphur, and calcium in the true hemophiliac. He concludes that "there are certain bleeders in whom the disturbing factor seems to be a lack of calcium content of the blood and an inability on the part of the organisms to assimilate properly, the lime from the food."

The prognosis is particularly grave during the first year as Etlinger[13] has shown. The disease frequently disappears at puberty, in mild cases. Boys are worse risks than girls.[14] With sufficient care, patients live until middle life, the longer the patient lives, the greater the chance of out-living the tendency. The prognosis in each individual case should be based on the patient's history and that of his family.[13]

Treatment.—The treatment of such conditions naturally is empirical and will remain so until more definite causes have been found for these diseases. In the meantime, we consider the first step toward the successful handling of these unfortunate patients is to be on the lookout for their appearance, and if possible, diagnose the condition.

All careful surgeons, before any operative procedure, examine their cases so far as possible for such disorders of the blood in order to escape the misfortune which comes as consequences of operating upon such patients. Even after most thorough histories and physical examinations, patients occasionally first present this complication during the operation. Only the most urgent operations are performed on known hemophiliacs. However, the *clotting time* being normal, almost any operation is undertaken regardless of other preoperative findings. Hess says this is a mistake. He thinks that too great stress is laid upon the clotting time, especially of blood taken in the usual way; i.e., from a cut in the skin. He considers it far more important to get the clotting time of blood taken directly from the blood vessels themselves. In addition, puncture wounds should be noted for absence or presence of hemorrhage. In patients whose history points to this condition, we heartily recommend Hess' advice, otherwise we prefer to examine the blood from a cutaneous puncture, several separated drops having been placed upon a clean glass slide. At the expiration of one minute, a pinpoint placed in one drop of blood will show a fine thread of fibrin if the blood coagulates so soon. If not, use another drop and repeat the maneuver until a thread appears and note the time. The fibrin should appear within three to five minutes.

According to Morris,[15] among the best methods of determining the clotting time is one which utilizes the apparatus of Brodie and Russell as improved by Boggs.[16] Morris says that results nearly as uniform have been obtained by Hinman and Sladen,[17] who use a modification of Milian's idea. Since the apparatus required in the latter method consists of a plain glass slide and a millimeter rule only, we have used this method in cases requiring a more accurate determination of the blood clotting time. The method consists in aseptically obtaining blood from a blood vessel as suggested by Hess. Several small drops are placed upon a clean glass slide, by touching the undersurface of the slide to the hanging drop. The slide is turned quickly to prevent the drops from flowing and then placed over the millimeter scale. All the drops are wiped away except those measuring 4 and 5 mm. in diameter. The slide is held vertically and the profile of the drops watched. They first sag as would a tear, but as soon as coagulation takes place, uniform convexity appears.[15] It is also worthy of note that through transmitted light, the dependent portion of the drops appears the denser. When coagulation has occurred, the center of the drop assumes this density. The presence of a clot is confirmed by use of the pinpoint or by transferring the whole drop to a piece of cloth. According to Morris, 5-millimeter drops alone should be used in delayed clotting since the error due to evaporation is thereby markedly decreased. The mean coagulation time of all the 4 and 5 mm. drops of unknown blood, is taken for the result. The blood must clot below 8 min. to be considered normal with this method; usually normal blood does not clot in less than five minutes.

In Addis' 12 cases of hemophilia, the clotting time was from 15 to 85 minutes. In Morawitz and Lossen's case, the blood took 110 minutes to clot completely. Blood taken from the veins of such patients, 2 c.c. or more and placed at a temperature of 20° to 22° C., will not clot for hours.

The hemostatic measures which have been employed in the past are numerous. Excluding the direct measures, such as ligating the bleeding vessels, tamponading, etc., and considering drugs alone, the lactate of calcium is probably of most value, since in some of the instances the hemorrhage was associated with a lack of this mineral in the blood. These cases alone, however, can be benefited by such medication. Calcium will even increase the delay in the clotting time in some cases and its use should not be continued over too long a time.

Thyroid gland, 3 to 5 grains, three times a day has been successfully employed by Delace,[18] Rugh,[19] and others, both as a preventive and as curative means, particularly in hemophilia. Recently Witte's peptone has been highly praised by various European writers. Nolf and Herry[20] advise the injection of 10 c.c. of a 5 per cent solution in 0.5 per cent sodium chloride. The mixture is made by adding 5 grams of peptone, 0.5 grams of sodium chloride to 100 c.c. distilled water. Its properties are not altered by sterilization and it is given subcutaneously. Considerable pain is noted at times at the site of the injection with elevation of temperature. It is rarely necessary to repeat the dose more than once, usually after a day or more has elapsed. Nobécourt and Tixier[21] who probably have had the most experience with this treatment, give four to six subcutaneous injections of 3 to 5 c.c. of the solution at each injection two to three days apart. This can be given before operation or following it, but in either event, four to six weeks should elapse before a second series is given. Following this rule, no untoward symptoms developed after its use. Intolerance to peptone has been reported, however, but it followed the administration over too long a period of time.[22]

The use of fresh human serum has long been held to be the best agent for controlling this malady. It is asserted by some that Witte's peptone is better than serum but until it is proved, fresh human serum will remain the most efficient means we have to combat the dangers which follow operations upon patients with hemophilic tendencies. The investigations of Weil have resulted in this form of treatment. However, almost three years before Weil published his work, Bienwald,[23] Felz and Pigot,[24] Fry[25] and others had used fresh serum successfully in almost hopeless cases of hemorrhage due either to hemophilia or other of the hemorrhagic diseases. Weil's[26] observations were based upon the treatment of eleven cases of hemophilia in some of which the preventive use was made of the serum. He also used it in cases with marked primary and secondary purpura and in other hemorrhagic diseases, and concluded even at that early date (1906) that "fresh serum is an effective remedy for the arresting of hemorrhage in all dyscrasic states, in fact more effective than any other, including calcium salts." Weil's work was quickly confirmed by that of Elicagaray[27] and soon its use became general. Fresh sera from the rabbit, cow, ox, goat, and horse, were used and found effective. Baum[28] could not agree with all the findings of Weil but stated that he considered serum was indicated in all hemorrhagic conditions and would expect good results from it, except possibly in true hemophilia.

Following the injections of fresh serum, other *stock* sera were used and in some cases with good results. Diphtheria antitoxin,[28] tetanus antitoxin,[29] antistreptococcus[30] serum and other sera of various kinds were tried, but none with universal success. After extensive trial of sera, it was found that the serum from the ox, goat, and dog were particularly apt to produce anaphylaxis and it became so universally known that Trembur[31] in 1910, stated that the kind of serum should be changed at the slightest sign of such a condition. During the same year, Broca[32] considered the use of animal sera permissible for the arrest of hemorrhage in cases of true hemophilia only. One year later, Moss and Gelien used large intravenous doses of defibrinated blood which they hoped would not only furnish the element necessary to cause the coagulation of the blood, but also relieve the marked anemia.

Duke[33] considered the cause of the uncontrollable bleeding due to a deficiency or to an absence of the platelets in the blood in some of the hemorrhagic diseases at least. He therefore advised blood transfusion as the most efficient method of overcoming the condition. There can be no question of this being the ideal method easy of accomplishment. Satisfactory results have been reported by Goodman,[34] Murphy,[35] and others, in cases which no doubt would have terminated fatally if this procedure had not been resorted to.

Welch[36] in 1910 was so successful in treating hemophilic babies with fresh human serum that others have again revived its use. Among those who have employed this method in operative patients may be mentioned Meyer,[37] who used it as a preventive measure in cases of chronic jaundice and as a hemostatic in postoperative hemorrhages in such patients. Tilton[38] also used the fresh human serum successfully as a preventive treatment in such cases.

The amount of fresh human serum to be given depends on the individual case. In hemophilic babies, Welch gave 10 c.c. of the serum subcutaneously, repeated two and three times a day, but would give this dose every two hours if necessary. He states that the error most commonly made is the giving of too small doses. Meyer gave 30 c.c. subcutaneously three times a day for the first day, 30 c.c. each day for three days more just before the operation, and 30 c.c. during the operation. If there is a tendency to bleeding during the convalescence, the injections are continued. Usually 100 c.c. are given during the first day hemorrhage is noticed and the dosage gradually diminished until there is no further oozing. If the serum is given intravenously, the dosage is not so great; Weil would cut the amount in half as compared to the subcutaneous injection.

Welch positively states that serum sickness does not arise from the use of this serum but on the other hand "it is a perfect food already digested and ready to be taken up and utilized by the tissues and cells of the body." The subcutaneous injections do not cause pain and are most readily absorbed.

In securing the serum for injection, the donor must be healthy.

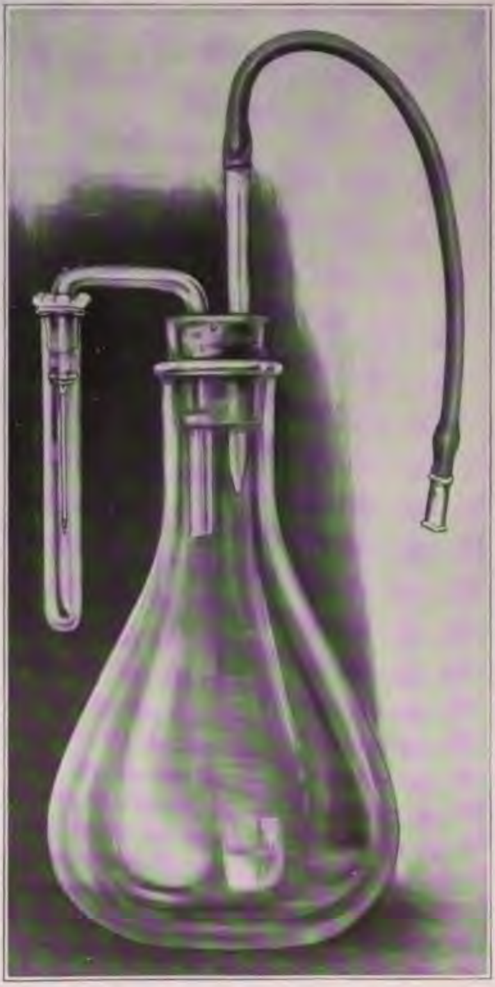

Fig. 49.—Apparatus used by Welch for collecting blood serum.

It is preferable to have a Wassermann done if possible. The collection may be easily accomplished by means of an apparatus which Welch first described in 1910, and which is shown in Fig. 49. The needle of No. 19 caliber, is plunged into the median basilic vein and the blood collected in the flask. When the desired amount is obtained, the flask is placed in a slanting position in a basin where it remains four to six hours. After this time, the serum will have separated and will be ready for use.

Locally, the same agents may be applied *to the oozing surfaces* as have been discussed for subcutaneous or intravenous use. If any of the stock sera are at hand, they may first be applied. It is not advisable to depend on any chemical, since none have proved trustworthy and the most efficient we have (adrenalin) may even cause a worse hemorrhage after the temporary effects wear off. Probably the quickest means at the surgeon's disposal, is to place fresh human blood on the surface. Sayer[39] recently stopped bleeding by applying a few drops of his own blood and other instances are reported in which relatives gave blood which was utilized in this way.[23] The thrombokinase, which seems necessary for coagulation may be supplied by kneading the tissues around the wound or by placing fresh tissue juices into it if fresh serum can not be had readily.[40]

As a last resort, while fresh human serum is being secured for internal medication, the bleeding surface may be seared with the cautery which is not at a *red* heat. Hahn reported two cases of hemorrhage from the gum and in which this most radical measure saved life.

Constitutional treatment should be continued several days after the local bleeding has stopped and general measures instituted which will help the patient regain the lost hemoglobin.

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CHAPTER XLII

ARTIFICIAL RESPIRATION

By Willard Bartlett and Adolph Rumreich

We will here consider artificial respiration as a resuscitatory measure. The historical development of the procedure will not be entered into here.

Resuscitation, which consists almost entirely of methods of artificial respiration, becomes called for in cases of suspended animation from any of a number of causes, such as excess of chloroform or ether anesthesia, morphia narcosis, acute cocaine poisoning, drowning, electric shock, gas poisoning (carbon monoxide), suffocation, increased intracranial pressure (e.g., with hemorrhage, meningitis, etc.) Respiratory embarrassment under general anesthesia will be chiefly kept in mind though most of the same general methods are applicable in respiratory failure due to any of the above causes. Artificial respiration in its application to thoracic surgery will not be considered here.

To be effective, artificial respiration, no matter by what method it is effected, must be instituted early, immediately after respiration has failed, if possible. It is also indicated, of course, whenever signs of impending cessation of respiration develop on the operating table. In all cases of suspended animation, the probability of restoration decreases, as someone has put it, in an arithmetical progression from the moment when spontaneous respiration ceases. The lungs and heart possess a considerable degree of irritability,[1] and the respiratory centers have a stronger resistance than other parts of the nervous system,[2] but the weak point is the brain. After ten to fifteen minutes of complete circulatory failure, brain functions are not recovered. In chloroformed dogs the time limit is even less.[3] In man, recovery is very uncertain beyond a ten minute interval. However, as the heart may beat for some time after respiration has ceased, so faintly as not to be detected, efforts at resuscitation should be persevered in.

Manual Methods of Artificial Respiration

Howard's Method.—In this, known also as the "direct method," the principle is active expiration by compression, and passive inspiration by the recoil of the thoracic wall. The patient is placed in the dorsal position, and a support, such as a pillow, is placed under the back, which produces hyperextension of the spine and renders the subcostal margin prominent. The operator places his hands over the prominent subcostal margins, the palms being below the margins, the fingers in the furrows between the ribs, and exerts pressure. The diaphragmatic ribs are thus depressed, the abdominal contents push the diaphragm upward, and the spine is partially straightened. The recoil after release of the pressure effects inspiration. With this method an abdominal type of respiration is produced. Advocates of it claim as an advantage that the blood is forced through the pulmonary circulation.

Silvester's Method.—This was termed by the originator the "physiologic method." The patient is in the supine position. The operator stands at the patient's head, and seizing the bent arms above the elbows, lifts them towards the patient's chin, thus rendering the pectoral muscles taut. This effect is increased by everting or laterally rotating the arms as they are lifted. The arms are then carried back towards the patient's ears; the humerus and shoulder are thus used as levers and the anterior wall of the chest is raised upward and forward. The arms are held thus extended for a second or two; expiration is then produced by pressing the patient's arms firmly against the lateral walls of the chest. The rate should be about fifteen times per minute.

Brosch's Modification of Silvester's Method.—1. After the arms have been extended as recommended by Silvester (Fig. 50), the movement is continued forcibly until the arms actually touch the table on which the patient is placed. This causes the body to arch upward so that it rests on the table only at the shoulders and heels; the spine is hyperextended. Withdrawal of the force lets the body recoil on the table, and collapse of the chest commences. 2. In the respiratory movement the patient's arms are pressed directly over the sternum and the costal cartilages (Fig. 51), which are forced inwards. By this method a maximum active inspiration and a maximum active expiration are secured, and a respiratory exchange greater than by any other method, as measured in cubic centimeters per minute, is obtained. Some have even recommended additional pressure on the abdomen[4] or the addition of Howard's method[5] to augment the effect. The danger of acapnia by overventilation (Haldane and Henderson) with such a procedure has been pointed out, while the hyperpnea produced may even lead to death through shock.[6] The expiratory maneuver of Brosch's modification of the original Silvester method is generally acknowledged as a valuable feature and is now widely used.

Silvester-Howard Method.—The operator performs the maneuvers of the Silvester method, while an assistant synchronously goes through Howard's maneuver—thus effecting greater ventilation.

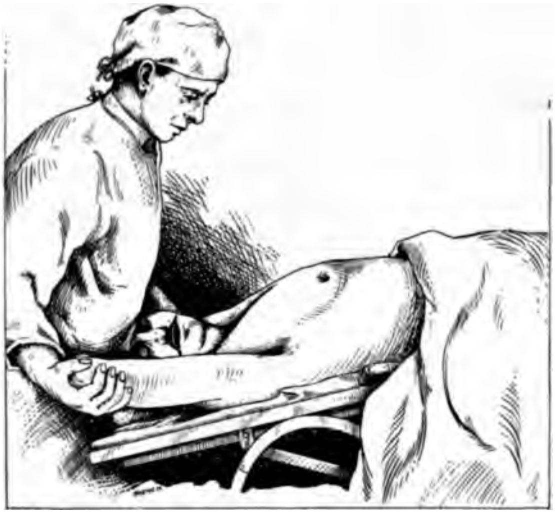

Fig. 50.—First act in the Sylvester method.

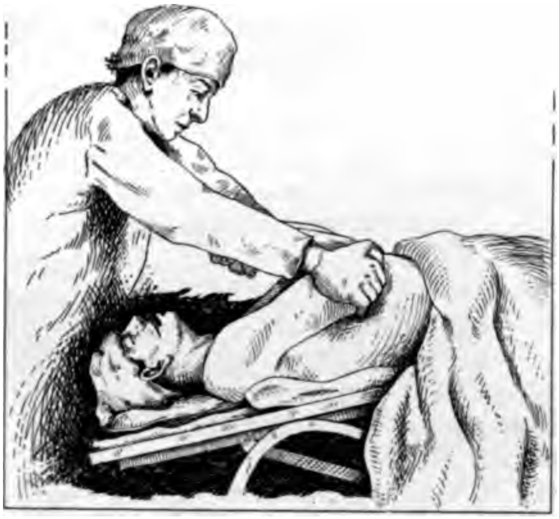

Fig. 51.—Second act in the Sylvester method.

In any supine posture method the position allows the patient's tongue to fall back against the posterior pharyngeal wall, and the epiglottis to close the larynx. The tongue should therefore be secured. If the patient is in a supine posture, the head should hang down over the edge of the table, or the shoulders may be elevated so as to lower the head; the head and neck are to be extended as much as possible. Howard showed that by this procedure the epiglottis is completely removed from the glottis, and a free passage of air is allowed. Martin and Hare, however, showed that this position causes the soft palate to strap itself over the root of the tongue so as to cut off the entrance of air through the mouth. They proved that if the head be extended and at the same time projected forward, the above condition is obviated, and at the same time the epiglottis is well raised from the glottis, thus permitting free breathing through both mouth and nose.[8, 9]

Schäfer's Prone-Pressure Method.—By this method the lower part of the thorax is compressed, and in addition the diaphragm forced upward by the abdominal viscera. The patient is laid in the prone position, the face turned slightly to one side, so as to leave the nose and mouth free for breathing. An assistant draws the tongue forward. The operator kneels beside or straddles the patient's thighs, facing his head, and applies his hands to the back, one on each side of the spinal column, the palms on the muscles at the small of the back, thumbs nearly touching each other, and fingers spread over the lower ribs. Keeping his arms straight, the operator with a forward swing throws the weight of his body slowly upon the patient, thus causing contraction. This movement takes two to three seconds. He then raises his body and relaxes pressure, allowing the thorax to expand by recoil. After two seconds the movement is repeated. The complete movement thus occupies four or five seconds, giving a rate of 12 to 15 times per minute. The method is rendered more effective if the arms are extended forward as straight as possible.[7]

There is considerable controversy over the merits and faults of the various manual methods. All have been accused by the opponents of causing rupturing of the congested liver or fracturing the ribs, especially in old persons. These accidents are very rare and are manifestly due to improper technic.

The prone posture permits mucus and saliva, which are secreted excessively in general anesthesia, to flow out of the mouth. Of the supine posture methods the Silvester method with the Brosch expiratory modification is most widely used. The choice of position and method is evidently determined by the conditions in each case where employed during a surgical operation.

Artificial Respiration with Apparatus

Pulmotor.—This is an ingenious mechanical device, consisting of a tank of compressed oxygen, connected through a reducing valve with an injector to draw in air, a hose delivering the air-oxygen mixture to a close-fitting face mask, and an automatic mechanism to regulate expiration and inspiration. Serious faults were found by the Commission on Resuscitation;[7] among them, that any obstruction to the flow of air will cause such a rapid succession of suction and injection as to make the apparatus inefficient and that the automatic reversal mechanism readily gets out of order.[7] The "Pulmotor Model B" is a newer apparatus, in which the automatic feature is replaced by a hand control. Compressed air or oxygen or an electric air blower may furnish the motive power. This form of instrument is preferable to the automatic type. The latter in fact should be condemned. As to the actual amount of oxygen delivered in the air-oxygen mixture, Haldane and Henderson found it to be only 26.75 per cent, which is not much enrichment, considering that pure air contains 21 per cent oxygen.

The Dr. Brat apparatus is similar to the pulmotor, except that it feeds pure oxygen, and produces greater pressure and suction. It is hand regulated.

Lungmotor.—This device consists of two pumps, connected by a hose to the face mask, and so arranged that the down-stroke injects air, while the up-stroke produces suction. An oxygen tank may be connected up and the injected air enriched with oxygen to the desired degree.

Several other devices, all similar to those above described, and made on the same principle, are on the market. Objection has been offered to the suction feature of these devices by the Commission on Resuscitation[7] and others on the ground that it causes collapse of many of the alveoli, which then stick together and are not effective, also that it causes collapse of some of the bronchioles, which traps a certain amount of air in a dead space, the movement of which simulates respiratory movements with an actually lessened gaseous exchange.

Meltzer's Pharyngeal Insufflation Apparatus.—[10, 11] With this apparatus the necessary inspiratory pressure is obtained by means of a foot bellows, [illegible] or other source of constant pressure. The air or oxygen is delivered by a hose to the pharyngeal tube, which is so constructed as to close the entrance to the nasopharynx and thus prevent escape of air through the nose, while it permits it to enter the lower pharynx freely. A slight escape through the mouth, around the tube, is negligible but usually there is none. The pharyngeal tube also has a hole through which a stomach tube (size 33 French) may be, and preferably should be, introduced, to permit the escape of any air reaching the stomach. A respiratory valve is inserted in the connecting hose. This valve is regulated by the operator, alternately allowing an inspiratory blast and the escape of expiratory air, A large rubber bag is interpolated between the valve and the source of pressure. A T-tube with a clamp-screw on its free rubber end is interpolated between the respiratory valve and the pharyngeal tube; this regulates the amount of air intake. A padded wooden board is used to compress the abdomen by means of belts. This prevents the entrance of air into the stomach. It may thus be used to supplement the stomach tube, or either may be used alone, depending on circumstances. A further advantage is claimed for the board, that its use drives blood from the splanchnic area toward the heart. In applying the apparatus, the tongue is pulled out by forceps, and after the pharyngeal tube has been inserted, the tongue is tied to it by means of tape. This prevents the tongue and glottis from falling back, and also keeps the tube in place.

This method has been reported to be very efficient, and was recommended by the Commission.

Intralaryngeal Insufflation.—Among the devices for effecting intralaryngeal insufflation are the Fell O'Dwyer apparatus, with bellows; and the apparatus devised by Matas,[12] consisting of a modified O'Dwyer cannula connected with a graduated, adjustable pump for injecting the air, but with no return suction.

Intratracheal Insufflation of Meltzer and Auer.—Meltzer considers intratracheal insufflation the most reliable method of artificial respiration; and its use has been recommended wherever possible. An endotracheal tube is introduced instead of the pharyngeal tube, otherwise the same apparatus may be used.

As to the comparative efficacy of the manual and the mechanical modes of artificial respiration, the claims are somewhat conflicting. The best authorities, however, hold that in cases in which natural respiration has ceased but the heart still beats, artificial respiration by apparatus (pump or bellows) will maintain life more easily and much longer than employment of either of the two most widely used manual methods, the Silvester and the Schäfer.[13] The weak point of the compression methods is the low ventilation, which decreases as the muscles of the body lose tonus.[14] The inflation methods unquestionably produce greater ventilation.

For the manual method, a noted physiologist[13] says: "I have a strong impression that during the first minute after the cessation of respiration (in anesthesia) the administration of manual artificial respiration is more effective than that by means of a pump or bellows, the reason apparently being that a slight assistance is given to the heart and circulation by the manual method which is not afforded by mere changes of air pressure in the lungs. Certainly both in the laboratory and operating room, the immediate application of manual artificial respiration is effective in restoring normal breathing." The objection has also been raised against inflation methods that they may injure the lungs by the violent aspiration.[7, 12] Keith[15] objects that inflation is not physiologic, i. e., does not correspond to the normal mode of producing breathing. He, however, states: "My mind is open to the conviction that the ancient method of mouth-to mouth insufflation with expiratory compression of the chest may not prove more effective than either Silvester or Schafer Methods."

Laborde's Tongue Traction.—This procedure is a valuable agent in reestablishing respiration. In anesthetic accidents, simple traction on the tongue a few times may restore breathing, acting in such cases by lifting the epiglottis and thus preventing its occluding the larynx.

Laborde's traction is executed thus: Grasp the tongue deeply so that the entire organ is acted on, draw it out forcibly and sharply, then relax suddenly and completely. Do this at a rate of about fifteen times a minute. This method acts by inducing reflex action on part of the diaphragm. Laborde traced the impulse through the glossopharyngeal and lingual nerves to the respiratory center, and thence to the phrenic and other respiratory nerves. The method is a valuable adjunct to the use of artificial respiration proper.

Stimulation of the Circulation

Artificial respiration acts as a circulatory stimulant by sufficient oxygenation of the blood; the contractility and conductivity of the cardiac muscle are increased and the heart picks up.

Heart Massage

Indirect or Extrathoracic Massage.—This procedure is often a valuable adjunct to artificial respiration. The massage is executed by rhythmical compression of the thorax over the heart by means of the hands. With some of the manual methods of artificial respiration heart massage may readily be incorporated into the expiratory maneuver, e. g., in the Silvester-Brosch method. Massage has also been done from the abdominal cavity through the diaphragm.

Direct or Intrathoracic Massage.—This method is much more effective, but is, of course, to be considered a last resort on account of the danger of the surgical procedure, of mechanical injury to the heart, and of the risk of infection. In anesthetic accidents the success of the method has been indifferent (Stewart).

Respiratory Stimulation

Sodium Cyanide.—Recently Loevenhart and associates[16] have secured strikingly good results in the use of sodium cyanide as a respiratory stimulant in respiratory failure due to increased intracranial pressure, deep chloroform and ether anesthesia, and some other conditions. The drug is administered by slow intravenous injection of the fiftieth normal solution (0.1 per cent). Response is quick. The injection must be properly controlled and the patient be under observation. The method is very promising.

Electricity.—The use of a faradic current for resuscitation purposes has been shown to be useless and may even be harmful.[8]

Adrenalin.—Adrenalin injected intravenously is said to be useful in circulatory failure. Experimentally, Crile and Dolley secured good results by intracarotid injection of adrenalin in saline infusion, directed toward the heart, combined with artificial respiration and indirect heart massage, in cases of complete heart failure. Crile has used the method successfully on human beings. There are others who do not approve the method.[2]

Oxygen Inhalation.—Compressed oxygen is widely used as an adjuvant to the various methods of artificial respiration. Objection has been raised to prolonged administration of pure oxygen.

Position.—The Trendelenburg posture has been advocated except when the face is cyanosed. It has also been cautioned against in persons with large abdomens, owing to the pressure of abdominal contents on the diaphragm. Application of heat, by hot-water bottles and hot blankets, is useful. Friction of limbs, slapping of the body or face with a towel wrung out of ice water, forcible dilatation of the sphincter ani, mechanical and chemical (ammonia) stimulation of mucous membranes of the nose, of the precordial or pudic regions or of the soles of the feet, are useful forms of stimulation and should not be neglected as adjuvants to the other methods used.

Full credit is due Adolph Rumreich for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER XLIII

POSTOPERATIVE FEEDING

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The problems of postoperative feeding have for the result of their solution the maintenance of body nutrition during a period of acute physiologic disturbance, and frequently, later, through a period of physiologic adjustment. It is often necessary to hold in abeyance for variable periods all energy intake and leave the body to continue on its own resources, which alone introduces all the alterations of normal metabolism incident to partial or complete starvation.

The first problem is the early resumption of food intake. Dietetics of postoperative conditions is based upon the fundamental facts of nutrition in an effort to approximate or maintain full nutrition, as well as may be possible under the limitations of disturbed physiology. The maintenance of nutrition during a postoperative course is quite as great a gain for the patient, as has been the maintenance of adequate nutrition in those infectious fevers, where formerly medical treatment included extreme starvation. The process of repair and the resistance of the patient are augmented and the convalescence and regaining of strength greatly shortened. Adequate nutrition can at no time be withheld without detriment to the body functions and in operative conditions where suspension of diet is unavoidable, the early resumption (Fig. 52) of partial or adequate nutrition is urgent, and offers the greatest aid to the return of normal physiologic adjustments and to the successful outcome of the surgical measures.

Physiologic disturbances result from various fundamental causes often irrespective of operative procedures. The pathology may be such as to alter metabolism or to present mechanical difficulties to ingestion and digestion, these latter not always being entirely relieved by the operation. The postoperative feeding must necessarily be adjusted to these uncorrected conditions. A diabetic should not have and could not utilize the carbohydrates which are otherwise of immediate preference in postoperative feeding. Stenosis of the esophagus, of course, is not relieved by gastrostomy. The physiology is further altered by the invasion of the disease into various organs necessary to the digestive process, or to intermediary metabolism. These considerations influence more the character of postoperative diet than its manner or degree. Anesthesia disturbs the mechanical functions of the gastrointestinal tract and the degree of this disturbance determines the time of resuming feeding and also the amount of feeding. General anesthesia also has a definite effect upon intermediary metabolism, promoting those conditions which give rise to acidosis with acetonuria, or acetonemia. Local anesthesia has no great or direct effect upon the mechanics of the gastrointestinal tract.

The physiologic processes are further disturbed by postoperative complications, among which the chief are infections, acute cardiac dilatation, acute dilatation of the stomach, intestinal ileus, hemorrhage, and shock, also pneumonia and cardiac disturbances.

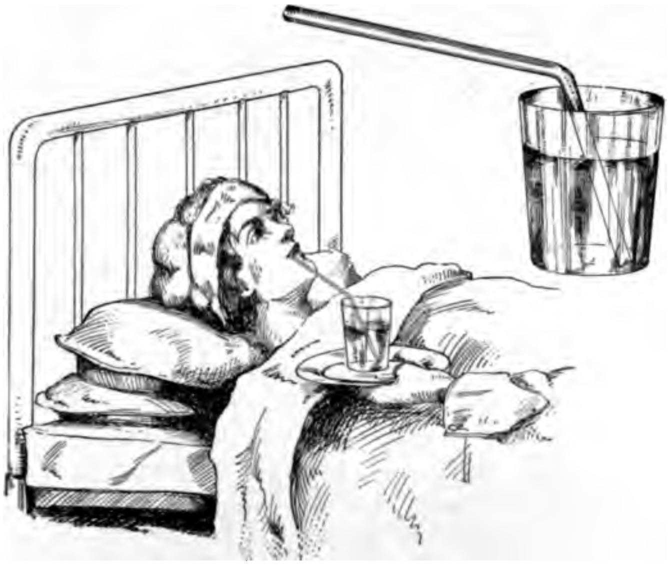

Fig. 52.—A convenient scheme for early administration of fluids.

The nature of the operation, of course, is most important, in anticipating or determining the nature and degree of the dietetic problems. Minor surgery seldom necessitates any postoperative consideration of diet. Major surgery will vary in its influence upon nutritional factors according as it involves structures removed from the enteron, or as it may be upon organs collateral to the enteron, or upon the tract itself.

The extent of the starvation period which is necessary following many operations is necessarily determined by the physiologic disturbances which have resulted and which would prohibit or limit feeding. The manner in which the patient endures this starvation period, especially if it be extended, will depend upon his preoperative nutritive condition. This often has been greatly impaired as the direct result of the pathologic and physiologic status of the disease. It is also determined by the manner of preoperative feeding which often has been practically a longer or shorter period of partial starvation, frequently to the point of establishing a marked acetonemia. Often one or several days of complete starvation have preceded the operation. Such conditions naturally lessen the facility with which the patient endures a postoperative period of complete or partial starvation. It is also probable that the acidosis and the increased H-ion concentration of the blood resulting from the preoperative starvation increases the detrimental effects of general anesthesia and promotes those conditions which simulate or may become actual shock. It is desirable that prior to operation the nutrition of the patient should receive careful attention and be raised to the highest possible level, continuing feeding even to a few hours prior to the operation. Other preoperative measures in management and preparation have their bearing upon postoperative feeding, especially those directed to the condition of the intestines. The colon should be empty. The manner of accomplishing this is important. Purgatives accomplish the result by a most violent, unnatural action, and they leave the intestines in a condition of marked peristaltic disturbance, and, as a collateral effect, disturb the vasomotor and other controls of the circulation of both blood and lymph. For such a result of purgation to be present at the time the abdomen is opened increases the tendency to shock and intestinal paresis, which may result from trauma and from the general anesthesia. It is best that the emptying of the colon by purgation should be accomplished a few days prior to operation. Parallel case series have shown that purgation just prior to operation increases the ballooning of the intestines and the difficulty of keeping them within the abdomen at laparotomy, and also greatly increases the frequency of postoperative gas pains and cramps. Animal experiments have shown that gas absorption as normally occurs fails in the purged intestine. In most cases where the colon needs attention, immediately prior to the operation, a large enema is usually effectual, and is the only measure without undesirable effects at laparotomy. It is also very adequate for all other operations.

Preoperative measures are, of course, not possible in emergency operations. In emergency laparotomies a large cleansing enema, (when allowable) is the most satisfactory preparation of the colon. In elective operations sufficient time should be taken (from two to seven days, or even more) to secure the best possible state of nutrition and gastrointestinal adjustment. With pyloric stenosis a few, or, in the lesser grades, several days of careful feeding and lavage once or twice daily will accomplish a considerable improvement in nutrition, and a lessening of the edema and the atony of the stomach walls, which will be very satisfactory to the operator and will facilitate postoperative gastric functioning. These days will allow for cleansing of the gastrointestinal tract by a laxative and enema and the return of normal peristaltic stability. If constipation has been usual with the patient, the use of small enemas of magnesium sulphate, three ounces of the saturated solution, will assist not only in the emptying of the colon, but will help correct also any spasticity which may be the cause of the constipation, and which would, postoperatively, be a factor in gas retention.

Nutrition should be brought to an adequate level, sufficient to relieve any acetonemia, which may have resulted from the patient's limitations of diet, self-imposed or otherwise advised. On the day prior to the operation it is desirable to force carbohydrate foods. This is an effort to hyperglycogenize the patient. I have noted in cases of rather extreme malnutrition, where a sufficient time could not be taken to correct the condition, or when the pathology obviated correction, that intravenous glucose injections gave splendid results in lessening the postanesthetic gastric disturbance and the urinary acidosis.

It is the aim of postoperative feeding to attain as rapidly as is safe the necessary energy-requirement for the basal metabolism of a patient under such conditions. The range of this energy requirement will be from 1000 to 2000 calories. (By a calorie is meant the amount of heat necessary to raise one liter of water through one degree of centigrade temperature.) This will vary according to many factors: (1) age; (2) according to the nutritive condition of the patient, whether emaciated, thin, robust, or fat; (3) according to any febrile condition present; and (4) according to the state of rest, whether sleeping, nervous, restless, etc. One effective guide to the adequacy of any diet is the acetone reaction of the urine, which will be positive when the diet is less than the starvation level. The total number of calories that may be given is, of course, not limited to the minimum energy needs. The patient should be given a very large energy supply when it becomes safe to do so, in a diet adjusted to the postoperative gastrointestinal situation and to any general condition. Ulcer of the stomach or duodenum and gastroenterostomy should be protected from recurrence of activity if the original ulcer has been untouched, or from the development of a stoma or jejunal lesion. Ileostomy necessitates providing the opportunity for the terminal ileum to assume the functions of the colon, and this is in large part done with dietetic measures. Such general conditions as diabetes, cardio-renal hypertension and gout must be considered in outlining the diet. The immediate postoperative problem is, however, to secure adequate energy intake. Fat is equivalent per gram to 9.3 calories; protein to 4.1 calories, and carbohydrate to 4.1 calories.

Carbohydrate is the type of food preferable in postoperative diet. It is quickly absorbed and easily available for energy. Dextrose itself is absorbed within 30 minutes (there being no gastric motor delay) and is immediately available for energy. Protein, by a specific dynamic action, raises the level of basal metabolism and increases the heat output of the body, and adds very considerably to the energy requirement. It is desirable only in moderate quantities. Protein is seen clinically to afford strength to a patient which can not be secured by a diet otherwise calorically adequate. This is perhaps directly associated to its specific dynamic action. Fat because of its high caloric value is of great advantage in securing high energy intake in a small bulk. It is often essential to calculate the percentages and caloric values of the diet. For anyone who does not use such data daily, and therefore does not hold it in mind, it may be readily found in any book on general dietetics. A guess at dietetic values can easily be wrong, and only by careful calculation can one be sure of adequate nutrition. In protracted and difficult cases, where a progressive increase in the diet is impossible, accurate calculation must be done to have any sure conception of the nutritional situation.

Fluid is volumetrically the greatest of the body's requirements, and this is greatly increased by postoperative disturbances. Water is lost by the body, not alone by the urine, but also through the skin and lungs, and this normally amounts to from 600 to 800 c.c. in a day. The loss of water vapor through the lungs and skin during and after anesthesia is very greatly increased. This dehydration of the patient occurs not alone from water lost, but also because all fluid intake is stopped or limited. The loss of fluids is further augmented by the creation of any drainage fistulæ, especially biliary. A postoperative diarrhea greatly increases the loss by preventing the body's water economy which occurs by resorption in the cecum. Postanesthetic vomiting may account for a great loss of fluids.

The measures of postoperative feeding may be divided into those directed to the immediate and acute situation, and those directed to the more remote problems. The immediate condition is in greater part the result of surgical wounds of the gastrointestinal tract and of the anesthetic. The great amount of water lost through the skin and lungs creates a greater or less degree of dehydration, which in any event it is important to quickly relieve. At times relief becomes urgently necessary. On the other hand, in the presence of circulatory disturbances, especially in the aged, and even when general dehydration is fairly extreme, there may be such a plethora of the lesser circulation as to contraindicate the addition of fluids by any other manner than oral administration. Water may be given by proctoclysis, hypodermoclysis or even intravenously. Should it be given intravenously, it is a great advantage to give a glucose solution, and thereby add a large energy quotient. This solution may range in percentage from five to twenty and should be made with anhydrous dextrose. Two to four per cent of sodium bicarbonate may be added if desired. It is also desirable that the proctoclysis contain glucose. Three to five per cent glucose solution is borne by the rectum about equally as well as tap water or saline. There is seldom any contraindication to allowing water in small amounts by mouth immediately after operation. Even with vomiting, fluid intake will often have a quieting effect, and if not, it will add greatly to the ease of vomiting, and will accomplish a spontaneous lavage of the stomach. However, unless relief is quickly gained more direct measures must be used and especially in laparotomized cases.

Gastric lavage should be used freely in the hours immediately postoperative, and is perhaps one of the most effectual measures in returning the stomach to the function where it will receive and allow the progression of food. This is especially true after stomach operations. These stomachs may retain, even without any retching or vomiting, and with perhaps nothing more than a slight nausea, very great amounts of hyperacid secretion mixed with old blood. Such retention increases the possibility of acute dilatation.

The progression in diet should be as rapid as is safe. Usually by the end of the third day all acute symptoms are past. The distention of the intestines postoperatively often gives great hindrance to increase in diet. Tympanitis is especially distressing. It interferes with proctoclysis and increases nausea and retching. The use of small enemas of magnesium sulphate as has been described above is very effectual in relieving the condition. When it is slight and unaccompanied by nausea and retching, the postoperative diet should not be stopped. Rather, the entrance of the food into the stomach is often a positive aid in the establishment of the normal reflexes and tonus, which will overcome the tympanitis, assist in the release of flatus, and secure the first postoperative defecation. There are those cases which upon each intake of food or fluid have an urgent desire for defecation or even intractable diarrhea. This is a disturbance in the autonomic nervous system and is controlled by liberal use of atropine to its physiologic limits.

Late after operation, vomiting is at times, even when the enteron has been untouched, perniciously prolonged without discoverable cause. It is apparently intractable, and nutrition suffers greatly. When there is no other accompanying condition which contraindicates, feeding should be continued and forced with a selection of the simpler mobile foods and an avoidance of cellulose roughage. Such vomiting is usually on a neurotic basis. It gives rise to an acetonemia which increases all general nervous disturbances. Usually by persistent feeding with consequent relief of the acetonemia and by the use of sedatives, this vomiting can be eventually controlled, and the patient returned to a normal diet. It is in these cases so often that rectal feeding is used. The absorption of other than the sugar content of any nutritive enemas is very doubtful. The use of other than the glucose proctoclysis in rectal feeding only clouds the estimation of the energy supply that is being secured and too often allows the assumption that greater help is being attained than is actually the case.

The remote problems of postoperative diet are directed to those conditions which will assist in a complete cure of the patient, such as the relief of constipation after appendectomies or hemorrhoidectomies; the fattening cure after nephropexy; the careful prescription of a nephritic diet following other kidney operations; and in the presence of a biliary or pancreatic fistula, the avoidance of those articles or types of food, which need for their digestion and absorption the secretions which are lost to the body.

The following postoperative diet, which is for a general application after laparotomies including gastroenterostomy, is very conservative, and when used routinely has given large advantage and satisfaction. Often it may be increased more rapidly than is indicated. It is often considered very unpalatable by the patient, and may have to be urged as a necessary measure similar to medicines.

Postoperative Diet

Preparation:	In addition to the preoperative diet, which should continue to and include on the evening prior to operation liberal liquid nourishment, give 3% glucose as proctoclysis, continuing from noon until morning after operation.
First Day: (Day of Operation)	3% glucose as proctoclysis. Water, small sips, ad lib.
Second Day:	X grains of Sodium Citrate in II ounces of water every 3 hours. Junket or oatmeal jelly, I ounce at a feeding, every 3 hours; to alternate with Sodium Citrate Solution. Continue 3% glucose as proctoclysis.
Third Day:	Feed every 2 hours, alternating Junket, oatmeal jelly, or Bulgarian milk and cream (2/3 and 1/3); II ounces at a feeding. (One or two feedings during the night if awake.)
Fourth Day:	Feed every 2 hours. Same as on third day, plus custard, blanc-mange; gelatine, served with sugar of milk and cream. One seven-minute egg. 7:00 A. M. One-seven-minute egg. 9:00 A. M. Oatmeal jelly. 11:00 A. M. Custard. 1:00 P. M. Junket. 3:00 P. M. Blanc-mange. 5:00 P. M. Bulgarian milk. 7:00 P. M. Gelatine. (This order may be rearranged.)
Fifth, Sixth and Seventh Days:	Increase quantity to IV ounces with feedings 2½ hours apart. Same articles. Junket, oatmeal jelly, custard, blanc-mange, and gelatine, to be made up with sugar of milk (no cane sugar used in list).

Operations about the mouth, head, and mediastinum, even when of a minor nature, may give mechanical difficulties to feeding. This may necessitate the use of a tube for the introduction of food into the stomach. Infections accompanying or following surgical conditions introduce dietetic problems, chiefly because of the effect of the resulting toxemia upon gastric secretions and motility. Carlson states that experimental infections are shown to cause complete atony and absence of gastric hunger contractures and that bacterial toxins may depress the motor mechanism of the stomach directly, lower the vagus tonus, augment inhibitory reflexes, or induce excessive secretion of epinephrin. Cannon has observed that infections also depress the digestive peristalsis of the stomach and intestines in cats.

In the presence of such inhibitions from toxemia the size and character of the feeding must be of the simplest kind to obviate accumulation in the stomach and its attendant results; distention, belching, nausea and vomiting, and flatulence. This toxemia may even be a basis for an acute dilatation of the stomach.

In acute dilatation of the stomach following anesthesia, rest of the organ is imperative, and this will prohibit food and fluids by mouth. In all cases of persistent vicious vomiting, often with resulting acute dilatation, lavage is the greatest help. This should be used freely, and will give the patient more comfort and the surgeon greater protection against postoperative gastric conditions than any other measure. In dilatation of the stomach in soldiers due to anesthesia and shock and to toxemia, I have used, with very great success, the gastroduodenal tube for constant and interrupted drainage. The tube is retained in the stomach and, at first, constant drainage is maintained, allowing small amounts of water by mouth for lavage. When this lavage water only is recovered and no additional quantity due to secretion, then small hourly feedings of a simple nutrient fluid may be begun, and the tube clamped. The stomach is drained prior to each feeding. Comparison of the quantities given and recovered will indicate the degree of motor recovery of the stomach and determine when tube feeding and drainage may be discontinued. After shock, even water will be contraindicated. The engorgement which exists in all of the splanchnic area will allow no absorption, rather we may expect a secretion of fluids due directly to the engorgement. This will also necessitate lavage. It is doubtful whether in these cases proctoclysis is accomplished, due to a similar lack of absorption. The only routes for administering fluids in a condition of shock are subcutaneous or intravenous.

Peritonitis, when acute and general, indicates rest of the intestinal tract and the suppression of peristalsis. The general rule has been to avoid for long periods nutrition and fluid by mouth and to give nutritive enemas. The latter doubtless will create as much peristaltic unrest as will bland and nonstimulating fluids by mouth. It must be remembered that the infection itself has inhibited peristalsis. Often, however, associated vomiting will prevent oral feeding. Flatulence and fermentative processes are dangerous and the residue starches must be avoided. Nutrition becomes imperative if the patient's resistance and recuperative powers are to be supported and maintained. The surgical postoperative diet, as has been given, but with slower progression, can be used to advantage in this condition. An initial starvation period of 48 hours should be used, but feeding should be started early enough and in sufficient amount to prevent acetonemia, which is the first indication that nutrition is beginning to suffer. In localized, acute peritonitis the dietetic principles are the same as in general peritonitis.

In chronic peritonitis, which is usually of tuberculous origin, there is often an accompanying diarrhea, perhaps due to exudative processes and perhaps to lack of absorption. Depending upon the degree of this disturbance, the food must be more or less residue free. In any case there must be a simple, bland diet. Hypernutrition is not contraindicated. Flatulence and the distention of the bowels are to be avoided.

In cases of obstructive jaundice relieved with a biliary fistula, there is a large danger of a yellow atrophy of the liver with fatal termination. The liberal use of carbohydrates is of the greatest service not alone in nourishing the patient, but in the protection of the hepatic parenchyma. The enterol digestion of carbohydrate is more complete than that of other foods where there is a partial or complete absence of bile in the intestines, and the liver is relieved of its metabolic functions, in handling fat especially, and also the protein products. The carbohydrate has been shown to have a direct protective action. The postoperative diet of gallstone cases should be very poor in fat, and obese patients should be urged to reduce. The hypercholesterinemia which is present in these cases is thus corrected.

CHAPTER XLIV

REDUCTION OF OBESITY

By Willard Bartlett and Alfred Goldman, St. Louis, Mo.

The postoperative treatment of the obese is of especial interest from two standpoints: first, directly, by aiming at the particular organ or region involved; second, indirectly by building up the general condition of the patient. The treatment of obesity is of importance after abdominal operations, where an excessive panniculus and subperitoneal fat are prone to produce postoperative hernia. It is also of importance in that it improves the cardiovascular, the respiratory, the digestive systems, the smooth working of which is essential to a good recovery. Moreover it seems a most logical thing to start the treatment of such a condition after a surgical operation; first, because the patient's metabolism is of necessity much deranged, his ingestion considerably diminished, etc; second, because a rigid reduction treatment must be carried on under careful supervision to be effective, preferably therefore in an institution.

It is essential to determine when a reduction is indicated. When this is determined and the proper methods of treatment applied, then a reduction will strengthen the patient. The indications have been aptly considered in this class of cases by von Noorden and others.

A high degree of obesity,[1] which may be arbitrarily taken as 70 pounds or more than the weight corresponding to a normal individual of the same height is always to be considered as an indication for reduction. In children and in the aged, one should be careful in advising treatment.

A moderate degree of obesity (40-70 pounds over weight) is an indication for reduction in the young and middle-aged, unless there is some special contraindication. In older people, as a rule, it should not be advised.

A slight degree of obesity, (20-40 pounds over weight) is not an indication for treatment, unless there is a tendency for the condition to be aggravated. In such a case, reduction can be made very effective with slight restrictions.

Certain special conditions call for a reduction cure, even in mild cases of obesity. They are diseases of the circulatory system, chronic bronchitis, or emphysema, in which the removal of an excess weight will enlighten the burden of the various systems. In contracted kidney, reduction should be very gradual. Advanced age is a contraindication. Diabetics and gouty individuals do better when there is a certain degree of obesity. The same may be said of cases of pulmonary tuberculosis.

Any rational treatment of obesity must, of course, seek to do one thing, namely, to make the expenditure of energy greater than the energy intake of food. This means that the body makes up its deficit from its own tissues, and as is well known, will obtain this chiefly from its adipose supplies.

Obesity may be due to many various causes. Before devising a plan of treatment, it is essential to obtain an accurate account of the habits of the individual, for treatment must be adapted to fit the cases. If there is an outstanding etiologic agent, this should be removed first. All dietitians consider treatment under three heads: dietetic, mechanical and medicinal.

1. **Diet.**—All rules in regard to dietary measures should be based on caloric feeding. The food must be weighed and measured, at least at first, and the patient must be accurately weighed at short intervals.

There are a number of "systems" in vogue, the principal ones being those of Banting, Ebstein, Oertel, and von Noorden. In Banting's[2] method, sugar, fats and starches are greatly restricted; water is not reduced, and alcohol is allowed. This system with its high protein content and small amount of food in general, has been called "unphysiologic and impractical."

In Ebstein's[3] system, the proteins and carbohydrates are diminished and fat is increased. Ebstein found that when fat forms a large element in the diet, a feeling of satiety is readily produced, so that the total food contains fewer calories. This does not always hold by any means, since the patient may soon cease to be affected in this manner.

Oertel's[4] method is good for cases of obesity with weak hearts. Oertel allows little fat but more protein and carbohydrate than Ebstein. Water is greatly diminished, only one pint of free water being allowed, and one pint along with the food. His diet-table follows:

	Albumin	Fat	Carbohydrates	Calories
Minimum	156	25	75	1100
Maximum	170	45	120	1600

The following is an illustration of Oertel's dietary:

Morning: A cup of coffee or tea with a little milk about six ounces (178 c.c.) altogether; bread, three ounces (93 gm.).

Noon: Three to four ounces (90 c.c. 120 c.c.) of soup; 7-8 ounces (218 gm. to 248 gm.) of roast beef, veal, game, or poultry; salad or a light vegetable; a little fish, 1 ounce (32 gm.) of bread or farinaceous pudding; 3-6 ounces (93-186 gm.) of fruit for dessert. No liquids at this meal, as a rule; but in hot weather 6 ounces (178 c.c.) of light wine may be taken.

Afternoon: Six ounces (178 c.c.) of coffee or tea, with as much water. An ounce of bread.

Evening: One or two soft-boiled eggs, 1 ounce (32 gm.) of bread, perhaps a small slice of cheese, a little salad, and fruit; 6 to 8 ounces (178 c.c. to 236 c.c.) of wine, with 4 or 5 ounces (120 c.c. to 148 c.c.) of water.

Some[5] cases of obesity are due mainly to an excessive amount of water in the tissues. In such a case, Ranke's diet is to be recommended, meat, 280 gm.; fat 100 gm.; bread, 400 gm.; the limitation of the amount of fluid ingested, allowing only 400 c.c. more water to be taken daily in drink and food than the daily amount of urine secreted. To carry this out, the percentage of water in different forms of food must be estimated.

Von Noorden's[1] dietetic measures are widely recognized and are based on scientific principles. In every case a general estimate should precede the actual reduction cure in order to determine the patient's "maintenance diet." Since the obese tissue does not participate in energy production one must calculate by how much the weight of a stout individual exceeds that of a normal person of the same height. The number of calories essential are obtained by multiplying the body weight by the caloric value per kilo.

The maintenance diet of an obese patient is then the caloric value per kilo, multiplied, not by the weight of the patient, but by that of a normal individual. Of course, there are certain errors involved, but for practical purposes this method suffices.

Von Noorden[1] recognizes three degrees of reduction diet. If, for example, the maintenance diet of an individual is estimated at 2500 calories, the three degrees of diet reduction would be: (1) four-fifths of the demand, or 2000 calories; (2) three-fifths of the demand, or 1500 calories; (3) two-fifths of the demand, or 1000 to 1500 calories. For Diet I, omit all visible fat, as butter, oil, meat fat; also prepare vegetables and dishes made from flour with little fat.

This measure would cut calories down to 2000. For Diet II, besides the above, dishes from flour, stewed fruits, and milk, must be omitted. These patients should eat abundant albuminous foods, as lean meat and cheese.

For Diet III, the following articles of food should comprise the diet: Coffee, tea, meat broth (fat skimmed off) with vegetables, lean meat or fish, lean cheese, abundant green vegetables and salads with little fat and oil; vinegar, lemon, pickles, tomatoes, celery, radishes, raw fruit, with small percentage of sugar (apples, peaches, strawberries, raspberries, currants, blueberries, grape-fruit, early oranges), coarse bread (bran or graham) in quantities from 40 to 70 grams, potatoes (in quantities of 80 to 150 grams), mineral waters *ad libitum,* one to two eggs, skimmed milk, and buttermilk.

A diet of low caloric value should be made up from the foods mentioned.

In analyzing this dietary further, one should consider the relative amounts of fats, carbohydrates and proteins, and the question of water ingestion. Fats are very much diminished, down to 30 grams per day. Lower than this one can not go because many of the essential foods contain some fat. Carbohydrates are high in von Noorden's system. One hundred to one hundred twenty grams per day should be prescribed. Such an amount can be procured from 500 gm. potatoes, 100 gm. coarse bread, or 1000 gm. apples, etc. The reason for allowing large amounts of carbohydrate is that the body albumin is spared. Also carbohydrate food occupies a large volume and tends to be filling. It is essential that the patient's sense of hunger should be satisfied, otherwise his strength and energy are diminished.

An abundant amount of protein is advisable, this to be obtained from lean meat, eggs, and cheese. One should begin with 120 gm. of albumin and gradually increase to not more than 180 gm.

The diet in Reduction III may then be tabulated as follows:

Minimal			Maximal		
Albumin	120 gm.,	490 cal.	**Albumin**	180 gm.,	738 cal.
Fat	30 gm.,	280 cal.	**Fat**	30 gm.,	280 cal.
Carbohydrate	100 gm.,	410 cal.	**Carbohydrate**	120 gm.,	492 cal.
		1182 cal.			1510 cal.

The question of water ingestion is a much disputed one. Certain it is that reduction of water will reduce appetite in some cases, but in many it will not. Water restriction is advisable in circulatory disturbances. In most cases, von Noorden permits free use of fluids in the form of plain water, alkaline waters, coffee, tea and broths.

There is one very essential point which most "cures" disregard, namely, that the future mode of life of the patient must be considered. It is useless to institute a cure which the patient will not continue to follow and therefore once more reestablish his obesity. On this account one should adhere as closely as possible to the ordinary mode of life of each individual and make restrictions accordingly. One must also not fail to vary any routine occasionally.

2. **Mechanical Treatment.**—Mechanical treatment, the purpose of which is to increase oxidation, comprises (1) exercise, (2) massage, (3) hydrotherapy, (4) "passive ergotherapy."

1. *Exercise* causes[6] direct destruction of the fatty deposits of the body. In postoperative conditions, of course, intensive exercise is impossible at first. Breathing exercises are generally permissible. Various trunk and hand movements may be tried, systematically and frequently. As soon as the patient is allowed on his feet, if there are no contraindications, walking out of doors, climbing, gymnastics for trunk and limbs, milder games,—all are invaluable in the successful treatment. The patient's cardiovascular system must always be considered in advising exercise.

2. *Massage* may be of value, particularly in reduction of local deposits, as of the abdomen. A course of deep massage with Swedish movements should be tried.

3. *Hydrotherapeutic*[7, 8, 9] measures are often of great value. Sweating by means of the steam or Turkish baths, etc., may produce marked loss of weight, but as a matter of fact, the loss is chiefly of water, which is soon replaced. Sweating causes no loss of fat. In patients with circulatory disturbances and edema, sweating is recommended. When this is done in conjunction with cold bathing, however, much may be accomplished. Following the sweating, the patient takes a cold bath or cold sponge and a cold rub. Exercise following this is very effective. This method stimulates the circulation and respiration and causes destruction of fat. Milder measures, as cold rain douches or cold sitz baths during the day, may be undertaken.

4. *"Passive Ergotherapy."*—Recently much attention has been drawn to "passive ergotherapy" or "electrically excited muscular work." This method, as defined by Smith,[8] consists in an application of the faradic current by which the muscles, in groups or in entirety, are thrown into rhythmic contractions, "without dis-

comfort or fatigue to the patient, without strain on the heart, and with beneficial effect on the muscles themselves." The faradic current is provided by a coarse-wound coil, capable of giving a large output at a low voltage. The electrodes are large metallic ones, the supply to each being controlled by rheostats. The method[10] is applicable particularly in those cases of obesity in which muscular exercise is difficult, as in cases of very extreme obesity, of complicated heart affections, of foot or joint troubles. In cases of weakened abdominal muscles, so often coexistent with obesity, passive ergotherapy is especially indicated. The current is directed to the muscles themselves. This method of reduction protects the heart upon which voluntary muscular exercise may have a detrimental effect.

3. **Medicinal Treatment.**—On the whole, the many varied mineral water cures give but temporary relief. They are therefore neither satisfactory nor successful. Thyroid extract is probably the only drug which is effective. Its use, however, should be limited to cases showing hypothyroidism. There are some patients who do not respond to even strict dietary measures and vigorous mechanical processes, also others in whom fat is quickly regained. In them one should suspect hypothyroidism and a justified etiologic treatment may be instituted; i.e., feeding of thyroid preparations. They should not be given in those cases of obesity due to overfeeding or lack of exercise, because such treatment does not aim at removal of the real cause. The thyroid preparations should be given along with full maintenance diet and large amounts of albumin. It is best to start with small amounts and slowly increase to three to five grains three times a day. Larger quantities will produce irritability of the heart.

Dr. Stuart McGuire presents these instructions to patients who are subject to *obesity* as they leave the hospital.

Your wound requires no further attention.

An abdominal binder should be used, both day and night. During the day a comfortable corset may be worn over the binder.

You may safely walk at once. Start with a short walk, the distance of two or three city blocks, and increase gradually.

Go slowly. At first you should be cautious even in such matters as straining at stool, getting in and out of the bath tub, and the like. Tub baths are not, however, objectionable. For three to six months be careful about getting on and off cars, lifting weights, the use of the sewing machine, athletic sports, heavy manual work, etc.

Drugs such as thyroid extract, antifat cures, etc., should not be employed except under supervision of your physician. They are capable of harm unless properly controlled.

The following diet is adapted to a safe reduction in weight:

Take one pint of hot water slowly before rising or while dressing.

At the usual breakfast hour, take a cup of tea, or coffee, without milk or sugar, a small mutton chop or beefsteak, or one egg, and one slice of toast.

At 2 o'clock, eat all you desire of any one of the following meats and vegetables, the latter cooked without meat:

(a) Well-done roast beef, steak, mutton, fowl, or raw oysters.

(b) Spinach, tomatoes, cabbage, turnip tops, celery, parsnips, apples, rhubarb.

At 6 o'clock eat one slice of well-toasted bread and one poached or soft-boiled egg.

At bedtime take one pint of water.

Prevent constipation by exercise, a regular habit, and mild laxatives occasionally if necessary.

Open air exercise, gradually begun and progressively increased, and a tranquil mind are most important.

Avoid carefully bread, beans, peas, potatoes, all sweets and pastry, and fluids with your meals.

Strictly followed, this regime should reduce your weight one-half pound per day. If more is lost, let up on the diet every fifth day, and eat moderately of fruits.

Full credit is due Alfred Goldman for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER XLV

ARTIFICIAL NUTRITION

By Willard Bartlett and M. G. Peterman, St. Louis, Mo.

Modern artificial feeding probably began with Galen and Celsus. These men were the first to use rectal alimentation. Medicine has made considerable advance since the second century and artificial nutrition has become more and more important. The problem of artificial nutrition after certain operative procedures involves not only a question of the protein, carbohydrate, and fat requirement in the repair and up-building of tissues, but often presents a more serious and complicated phase in the administration of the body needs. The chapter on Dietetics deals with the proper foods after various operative conditions. It is the purpose of the authors to here consider the various difficulties which present themselves to the surgeon after operations which make it impossible, either temporarily or permanently for the patient to take food through the normal channel.

It may be well to mention the normal food requirements of the average individual, and the lowest limits on which the body can carry on its functions and processes without utilizing living tissues. The average adult consumes daily about 118 gm. of protein, 500 gm. of carbohydrate, and 56 gm. of fat, a total of 3055 calories.[1] Experiments have shown, however, that health and strength may be maintained on a diet of 20 to 30 gm. of protein, provided the necessary caloric requirement is made up with carbohydrate and fat.[2] Atwater gives a standard diet for a man at rest which consists of 90 gm. of proteins with carbohydrates and fat to make 2450 calories. In prolonged feeding the inorganic salt and the vitamine requirement must also be taken into consideration.

The various methods by means of which artificial nutrition may be introduced are: per rectum; through gastrostomy or jejunostomy tubes, by subcutaneous injection, by intravenous injection, by cutaneous application, and by intraperitoneal injection. Of these various methods but two have thus far proved satisfactory for practical application. Nutrient enemas have been and still are the most satisfactory and practical solution of the problem of artificial feeding. Gastrostomies and jejunostomies are becoming more popular and more satisfactory, the latter being much easier to perform. We shall consider the methods in their order of practicability.

Per Rectum.—The old so-called nutrient enema consisting of milk and eggs, milk and bread, chopped beef, minced pancreas, or a combination of these foods still enjoys wide popularity in spite of its worthlessness. Modern investigation has shown that any of these food substances injected into the rectum serve little more than as irritants to the large intestine and a source of discomfort to the patient.

There is little doubt that digestion and absorption continue in the large intestine. The work of Erlanger and Hewlett proved that a dog may carry on digestion and absorption and thrive with 70 to 83% of his small intestine removed, provided that the diet be carefully chosen.[3] Recent work, however, has shown that absorption in the colon is limited to amino acids in their simplest forms and to monosaccharides, while the amount of fat absorbed may be said to be negligible. Water and alcohol are freely absorbed. The main function of the large intestine may be said to be the excretion of mineral salts and absorption of water. Of the reported cases of successful artificial nutrition by the old undigested or insufficiently digested nutrient enema one must be somewhat skeptical. Boyd and Robertson[4] report cases of seven young women fed for seven days entirely on enemata consisting of milk and eggs, dextrose, and normal saline, the whole pancreatized for twenty minutes. The cases were reported as having done well. Examination of the data, however, shows that the nitrogen excreted in the urine was always greater than that absorbed by the bowel. Also the patients continued to lose weight. Edsall and Miller[5] reported two cases of actual absorption of enemas of peptonized milk and eggs, but they give figures which show an average nitrogen loss of 11.8 to 79.9 gm. for the six day period. Carter[6] furnishes data on three cases of rectal feeding in a modern city hospital where nursing conditions were as good as can be found. In these cases the colon was cleared daily, the injections were given high up, and they were well retained. The 24-hour urine was analyzed and the results of the irrigation and all of the stools were examined. The results of the enemas were an almost complete return of the nutrient material with little or nothing absorbed. The nitrogen balance varied from -.8.81 to -.24.19 gm., always accompanied by a steady loss of weight. Goodall[7] concludes that the simple sugars and alcohol are the only substances practical for rectal alimentation. More modern results indicate, however, that proper amino acids added to the enemas produce good results. The work of Short and Bywaters,[8] where patients with gastric ulcer were treated by cutting off all food by mouth and feeding by nutrient enemas, shows that nitrogenous protein will be absorbed if it is properly prepared to make it available. These patients were given either normal saline or milk peptonized twenty minutes during the first four days and then changed to milk pancreatized for twenty four hours, to see if it would stop the fall in the nitrogen output. The enema was prepared by boiling the milk in a flask, adding two to four drams of pancreatized extract and incubating for twenty-four hours, then boiling. Five to eight ounces were given every six hours. The rectum was washed daily, but the washings were not kept. The nitrogen in the urine was estimated by the Kjeldahl method and the ammonia nitrogen by the A. P. Opie formalin method. These cases showed that it took twenty-four hours for the urine to show a rise in the nitrogen output after thoroughly pancreatized milk was fed. This time is required when mouth feeding is resumed after the same conditions and is therefore the time necessary for the body to restore normal equilibrium. The results of the experiments, on the whole, show a satisfactory result and justify the conclusions which the author draws, i. e., the daily output of nitrogen in the patients fed with enemas of milk and eggs peptonized for 30 minutes shows that almost no nitrogenous material is absorbed; that milk, pancreatized for twenty-four hours to allow the formation of the amino acids, furnishes food which is absorbed as demonstrated by the rise in the nitrogen output.

Cornwall[9] states the modern views when he sums up the essential points in rectal feeding. He states that all food should be predigested; that the protein ration must be considered in the terms of amino acids and of a definite variety in particular proportion to favor nitrogen economy. These amino acids are found in flesh, milk, and eggs. Flesh and eggs putrefy and are therefore not advisable. Milk is protected against putrefaction by the finely mixed lactacidifiable carbohydrate. Milk is therefore the ideal food and if properly prepared furnishes, when supplemented with the sugars, a practical and satisfactory solution to the problem of nutrient enemas. Cornwall believes that by using fresh and unboiled milk the vitamines and the enzymes are preserved. The milk should be thoroughly peptonized and pancreatized to reduce the proteins completely to amino acids. The fat must be skimmed from the milk, for it is not absorbed and putrefies in the intestine. To the prepared milk should be added glucose in solution. The salts contained in milk closely approximate the normal body requirements though calcium and sodium are only necessary when long-continued feeding is required. The solution prepared for the enema should always be alkaline. This avoids irritation and stimulates absorption. Also it more nearly approaches and preserves the alkalinity vital to the proper functioning of the body tissues. To these points may be added several precautions to be observed in the administration of the alimentation. The solution should not be a chemical or mechanical irritant. It should always be alkaline and it should be given to avoid irritation. If necessary opium should be added to the enema to allay inflammation. An inflamed mucosa will not absorb properly. The rectum should always be clean. This prevents putrefaction and hastens absorption. The enemas should be given high up and the foot of the bed should be raised on blocks with the patient lying on the right side. This position should be maintained for an hour after injection. The amount of material given should be carefully measured. Although the enema will not usually pass the ileocecal valve, the liquid may pass up into the ileum and may even reach the stomach presenting all the complications of acute dilatation. This condition is rather uncommon, but it must be borne in mind. In gastric conditions, it must not be thought that the rectal feeding gives the stomach complete rest. The injections are always followed by a reflex or psychic secretion. This secretion, though not excessive, must not be neglected in certain cases. The following formulæ for rectal feeding have been gathered from the literature where the records and data available have proved their merit.

Dextrose	50 gm.
Absolute alcohol	50 gm.
Normal saline	1000 gm.

This formula will furnish 555 calories of heat.[10] Larger enema in the same proportion or enemas in greater concentration are not advisable. Larger amounts are not absorbed and greater concentrations are too irritating.

The above formula may be alternated with the following:

Dextrose	20-50 gm.
Alcohol	20-50 gm.
Pancreatized milk or commercial amino acids	1000 c.c.
Salt	9 gm.

Of this preparation 250 c.c. may be given every 4 hours. It has a caloric value of 420-755 calories.

Short and Bywaters used the following preparation:[8]

Milk 1½ pt., boiled and cooled, to which was added
Pancreatic fluid, ½ ounce.
This mixture was incubated 24 hours, then there was added,
Dextrose (pure), 1½ ounces.

Four ounces of this material may be given every four hours, or ten ounces, if retained.

Cornwall gives the following excellent formulæ:[9]

Prescription 1.

Glucose (pure)		1 oz.
Strained juice of ½ orange.		
Sodium bicarbonate		30 grs.
Sodium chloride		30 grs.
Water	q.s. ad.	10 oz.

This mixture is given at 6 A.M., 12 M., 4 P.M., 10 P.M., and is altered with 5 oz. of skimmed milk thoroughly peptonized and pancreatized for 24 hours, which is given at 8 A.M., 6 P.M., 12 P.M.

With the above schedule a colonic irrigation of normal sodium chloride is given every second day and the glucose enema at 6 A.M. following is omitted.

This prescription may be modified as follows:

The quantity of glucose may be reduced to 8 oz.

The amount of glucose in the glucose enema may be reduced to ½ or ⅓ oz.

The amount of the glucose enema may be increased to 12 oz. or to 16 oz., with or without an increase in the percentage of glucose.

One-fourth oz. of glucose may be added to each milk enema.

The glucose enemas may be omitted altogether with or without the substitution of a drink enema of physiologic saline.

Five gr. of calcium chloride may be added to each glucose enema.

Cultures of acidophilic bacteria may be added to any of the enemas.

This formula supplies daily 700 calories, 20 gm. of protein, the necessary salts and vitamines, with 50 oz. of water.

Prescription 2.

Glucose		1 oz.
Str. juice of ½ orange		
Sodium bicarbonate		30 gr.
Sodium chloride		30 gr.
Water	q.s. ad.	10 oz.

This preparation is given at 6 A.M., 10 A.M., 2 P.M., 6 P.M., 10 P.M., 2 A.M.

The formula may be modified as follows:

The same modifications may be made of this preparation as of similar glucose enemas in prescription 1.

The sodium bicarbonate may be increased to 60 gr.

The orange juice may be omitted.

Calcium may be added.

All of the above preparations should be given at 100° F. and slowly. The buttocks should be elevated and the patient should lie on the right side for an hour after the injection. For real slow absorption the drip method may be used in administering the fluids.

Gastrostomy.—Artificial introduction of food into the stomach for practical purposes probably began when Kussmaul first introduced the stomach tube in 1870. Beaumont in 1826 fed St. Martin through an artificial opening into the stomach and was probably the pioneer in this field.[11] This work, however, was more in the nature of experimentation than practical feeding. Beaumont's valuable work is the foundation of our modern knowledge of the physiology of digestion. Although we can not accept all of his conclusions, we may gather much from his results. At the end of one experiment he states, "This experiment shows the necessity of mastication, and demonstrates that simple maceration at the natural temperature will not effect digestion." However, in his conclusions he states that, "The processes of mastication, insalivation, and deglutition, in an abstract point of view, do not affect the digestion of food or, in other words, when the food is introduced into the stomach directly (Fig. 53) in a finely divided state, without these previous steps, it is as readily and as perfectly digested as when they have been taken." The experiments did not state whether or not the patient was aware of the fact that he was being fed, or whether he was hungry or satiated. Both of these factors have considerable bearing on the digestion of food as modern investigation has shown.[12]

The later and more scientific work of Pavlov throws new light on the physiology of the stomach.[13] The Russian scientist concludes a lecture with, "I hope you have been convinced of the great importance of the passage of food through the mouth and esophagus, or, in other words, and this, according to our former experiences, means much the same thing; of the desire for food. Without this interest, without the assistance of appetite, many foods which enter the stomach remain wholly unsupplied with gastric juice." This statement he later limits by saying, "It is therefore quite possible that in the case of some dogs, and at a certain stage of hunger, the touching of the mucous membrane with any object at hand, its mechanical irritation, its distention by the food-mass may give the impulse which excites appetite; and when the appetite is awakened the juice flows." (Fig. 54.) Matas had kept a man in good health for fifteen years when we saw him, by the process here shown.

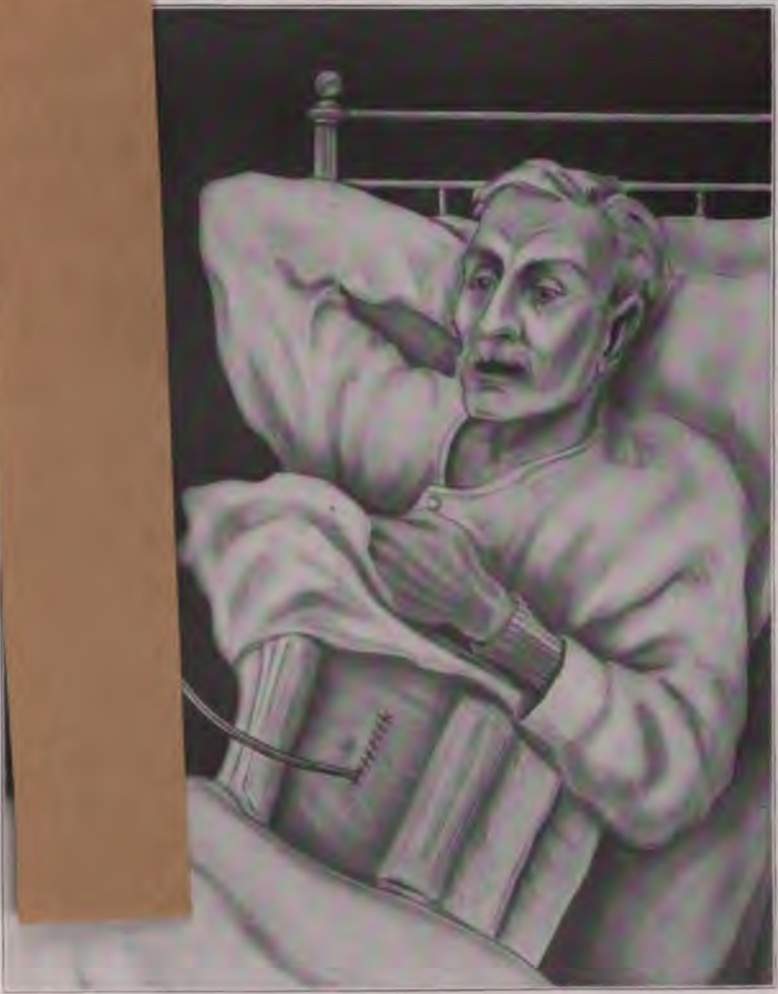

Fig. 53.—The introduction of liquid food, directly into the stomach.

For practical purposes we may assume that the stomach will digest almost any of the digestible foods which can be introduced through a tube. In other words, the diet in feeding gastrostomy cases is determined by the *condition* of the stomach. The sooner after operation the patient is supplied with nutrition and fluids, and the sooner normal peristalsis and the digestive action set in, the better the prognosis. Two excellent diets for gastroenterostomy or gastrostomy cases are given, viz.:

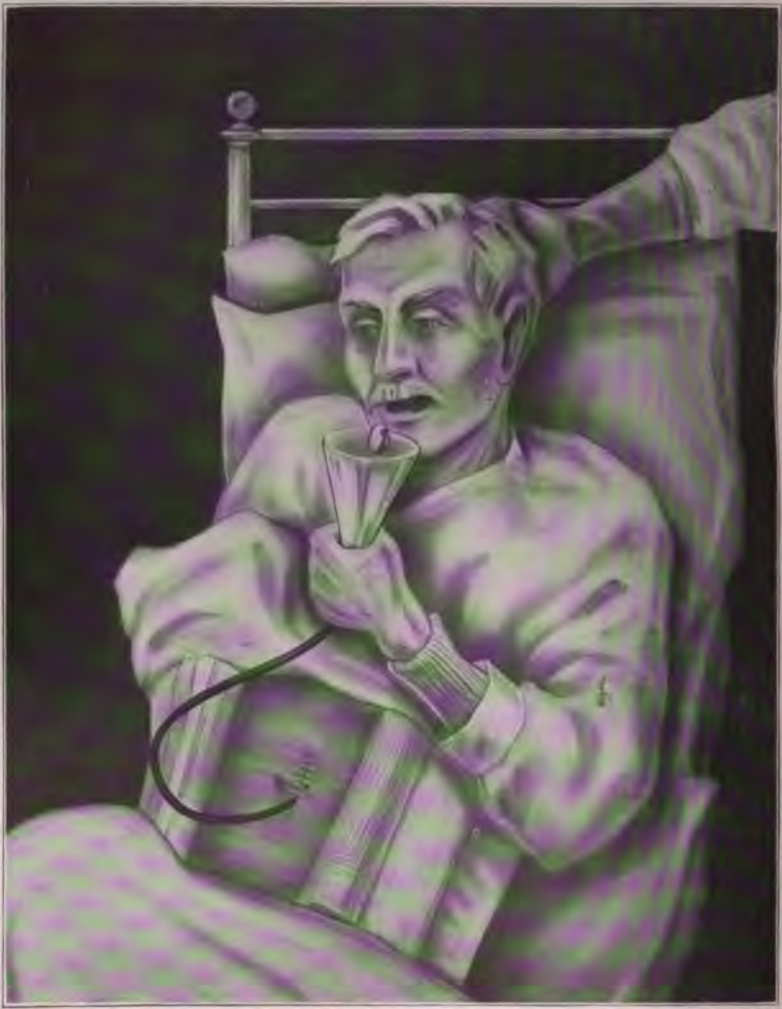

Fig. 54.—The patient first ensalivates his food and then sends it indirectly into his own stomach, which gives the best possible results.

Finney's Diet

First day. First 12 hrs., nothing by mouth, nutrient enemas every four hours, alternating with continuous salt solution by the drip method. Second 12 hrs., water in 4 c.c. doses by mouth. (By mouth or tube.)

Second day.—Increase water gradually up to 30 c.c. every 2 hrs.

Third day.—Water 30 c.c., alternating with albumin, 4 c.c., gradually increase quantities of each until,

Eighth day.—Any liquid, 60 c.c. every 2 hrs.

Ninth day.—Any liquid, 90 c.c. every 2 hrs.

Tenth day.—Any liquid, 120 c.c. every 2 hrs., discontinue rectal feeding.

Eleventh day.—One soft boiled egg in addition to any liquid.

Twelfth day.—Two soft boiled eggs in addition to any liquid.

Thirteenth day and Fourteenth day.—Soft diet.

Fifteenth day.—Very restricted diet, light.

Sixteenth and Seventeeth days.—Restricted light diet.

Eighteenth day.—Any digestible solid food.

After the eighteenth day the following diet list may be gradually followed and should be continued for at least four or five months: SOUPS. Any light soup. MEATS. Any easily digested meats as brains, sweetbreads, beef, mutton, lamb, poultry (minced and taken either broiled or boiled). FISH. Mainly the white variety, mackerel, bass as well as oysters (boiled or broiled). EGGS. In any form except fried. FATTY foods, as cream, butter, olive oil. VEGETABLES. The easily digestible forms, best taken mashed or strained as asparagus, spinach, peas, beans, potatoes, carrots, farinaceous foods, any cereals, stale bread. DESSERTS. Any of the light puddings. FRUITS, mainly stewed. DRINKS. Milks, buttermilk, cocoa, carbonated mineral water, and plain water.

The following must be avoided: Rich soups, pork, fried foods, veal, stews, hashes, corned meats, twice cooked meats, potted meat, liver, kidney, duck, sausage, crabs, sardines, lobsters, preserved fish, salted or smoked fish, salmon, cauliflower, radishes, celery, cabbage, cucumbers, sweet potatoes, tomatoes, beets, corn, salad, bananas, melons, berries, pineapple, hot bread or cakes, nuts, candies, pies, pastry, preserves, cheese, strong tea or coffee, alcoholic stimulants.

Leube's Diet, as Modified by Lockwood

On the second or third day, 2 oz. hourly of artificial Vichy, alternating with 2 oz. of milk fully peptonized for two hours. Each day the milk is increased 1-2 oz. until 8 oz. are taken every two hours and the Vichy increased 1 oz. each day until 4 oz. are taken every two hours. Thus fluids are given every hour, either Vichy, or the peptonized milk. At the end of a week or ten days there may be added junket, fine cereal, milk toast, and sometimes a soft-boiled egg. During the third week, creamed fish (fresh or halibut), mashed potatoes, cream of wheat, or hominy, spaghetti, puree of vegetables, and creamed soups. Farinaceous desserts such as farina, tapioca, cornstarch, blanc mange, and custard. Avoid alcoholic beverages for many months, but after the second week, weak tea, coffee, or cocoa, or a little milk and coffee, if it agrees, may be taken. The beverages should be weak and discontinued if they cause irritation.

Both of the above diets advise that no food be given for 12 hours to 24 hours after operation. More recent work, however, indicates that if feeding is begun immediately after operation, the results are much better. When the opening is completed the feeding is begun and 200 to 250 mils of whiskey, coffee, or other stimulant is poured down the tube. The fluid should be 105° F., and may be given by the drip method. After the operation, Andresen advises feeding certain definite amounts at definite intervals. He gives 200 mils of peptonized milk, 15 gm. of dextrose, and 8 mils of whiskey at 2 hr. intervals. This diet furnishes 2500 calories and may be altered according to conditions.

Jejunostomy.—Much has been written on gastrostomy, no doubt because it is theoretically the ideal procedure to supply food at the highest possible point in the digestive tube. In practice it has worked out so that we have never made a single gastrostomy, but many jejunostomies. The stomach has always been found shrunk and retracted, but the intestine vastly easier to handle. These have always been desolate subjects, hence it has seemed expedient to choose the method which most easily solved the surgical problem in hand.

The postoperative feeding is exactly the same, no matter which route for the introduction of food is chosen.

Intravenous.—The intravenous method of feeding is attended with danger and great care should be exercised it its use. For immediate results intravenous injections are of considerable value. The two formulæ following are taken from Carter's Nutrition and Clinical Dietetics.

Dextrose		50	gm.
Sodium chloride		9	gm.
Adrenaline chloride	(1-1000 sol)	10	gtt.
Aqua destillata	q. s. ad.	1000	c.c.

Filter and boil and give intravenously b. i. d.

For children:

Dextrose		55	gm.
Potassium chloride		.2	gm.
Calcium chloride		.2	gm.
Sodium carbonate		.1	gm.
Aqua destillata	q. s. ad.	1000	c.c.

Filter, boil and give intravenously b. i.d.

The above formulæ should be given in apparatuses which may be carefully regulated as to the flow. The fluid should be given very slowly to prevent excretion by the kidneys.

The excellent work of Woodyatt[24] throws new light on the intravenous injection of glucose. This work proves without doubt that a man of 70 kg. resting in bed may receive and utilize 63 gm.

of glucose by vein per hour without glucosuria. This means a caloric value of 6,048 calories! Thus we may inject an enormous caloric diet which will be readily utilized and give immediate results. Woodyatt mentions two precautions to be observed in the injection of glucose, i. e.— "—too great dehydration on the one hand, and heart failure from imposing too much mechanical work on the other. These can both be avoided by knowing the number of grams of glucose which enter the body hourly, what volume of water is moved by such a rate of sugar injection."

In using the injection of glucose for artificial nutrition the Woodyatt apparatus is advisable. This description of the mechanism is taken from the author's article which appeared in the *Journal of the American Medical Association,* December, 1915.

"The machine consists of a glass syringe barrel with a metal piston provided with a piston ring (record syringe), the barrel being fixed while the piston is actuated by a piston rod from an eccentric on a power shaft. The latter is driven by an electric motor through a worm and gear which reduces the speed of the motor and increases the power correspondingly. On the nozzle of the syringe there is a two-way all-metal valve of special design which is turned automatically by a cam shaft and alternately permits an influx or outflow of fluid to or from the pump barrel. The rate at which the machine delivers fluid is controlled in three ways: first by the size of the barrel, which is interchangeable so that any capacity can be used from .5 c.c. to 10 c.c.; second by a device which regulates the stroke of the piston to any desired length from a millimeter up, and, third, by a rheostat with which the motor speed can be controlled delicately while running so that the pump makes any desired strokes per minute between 15 and 60.

"The machine is intentionally provided with a surplus of power. It is heavily built and of a high grade of workmanship. It pumps precisely and relentlessly anything from water to an 80% glucose syrup, at any rate from 10 c.c. to 5 liters hourly, overcoming with negligible variations in speed any obstructions which may occur in the tubing or the intravenous cannula or needle. All parts which come into contact with the fluid to be injected are detachable and sterilizable."

Subcutaneous.—There is little to be found in the literature on successful results in administering nutrition via the subcutaneous method. This is rather a dangerous procedure and should not be resorted to until the other methods are unavailable. Among the more or less successful experiments may be mentioned the following:

Kreng[16] in 1876 stated that he successfully nourished a patient for 20 days on subcutaneous injections of olive oil, but he gives no figures or data as to the weight or strength of the patient during and after the feeding. Whittaker[17] in 1877 quoted a case of a man nourished for 6 days with subcutaneous injections of milk, beef extract, and cod liver oil. In report, however, he gives no data as to the body weight, the amount of food, or the excretion. Individuals may survive long periods and show little evidence of malnutrition. Unless the nitrogen output is measured, it is impossible to determine the exact condition of the patient. Eichorn[18] in 1881 published a report of feeding cow's milk, Sander's peptone, and egg albumin. He states that egg albumin injected subcutaneously produces abscess, and that cow's milk is only slowly absorbed, but that there is no reaction from the injection of 20 gm. of peptone. Eichorn concludes that peptone may be used to advantage. His work, too, lacks the necessary data to determine its worth. Leube[19] in 1895 injected sugar subcutaneously and determined that if a few c.c. were injected at a time 15 to 20 g.m. might be injected daily. He used a 20 per cent solution of glucose. This method is only an aid to be used in conjunction with other means. Perhaps with an apparatus similar to the Woodyatt intravenous contrivance whereby glucose could be injected slowly and at a definite rate, the subcutaneous route may offer more successful results. Barker[20] in 1905 stated that the glucose should be in 5 per cent solution in normal saline and reported several cases of artificial nutrition by this method. Henderson and Crofutt[21] in the same year found that oil injected subcutaneously was absorbed too slowly to be of value in nutrition.

Subcutaneous feeding may be best summed up with the original experiments of Carter.[22] A set of six experiments was carried out on a number of dogs. The animals were first placed on the normal laboratory diet and kept on this until there was no change in weight. All excreta was saved, the dogs were weighed daily, and they were carefully watched for clinical symptoms.

Experiment 1. Somatose and glucose were injected in normal saline. The first injection caused a severe reaction of toxemia. The dogs had a high temperature, marked trembling, and weakness. Later the toxemia became less marked, but the temperature rose, the weakness increased, and the urine showed hyaline and granular casts, albumin, peptones, and sugar, and a severe edema followed.

Experiment 2. The alkali albuminate of meat was injected. This was followed by a bloody diarrhea, vomiting, renal irritation, and local necrosis at the point of injection.

Experiment 3. Milk peptone with the cream removed, digested 3 hours with the dried extract of pancreatic gland and dilute sodium carbonate was sterilized by boiling. This preparation was fed to a pregnant dog. The injections were followed by only moderate symptoms of toxemia but there was a continual loss of weight. In a few days the dog delivered pups but only one lived. The mother was unable to nourish the pup and both died shortly.

Experiment 4. The milk preparation in Exp. 1, was fed to a normal dog, and toxemia followed.

Experiment 5. Skimmed milk was peptonized 1½ hours and was first fed by mouth until the dog became accustomed to the diet. Then the subcutaneous feeding was begun and the mouth feeding was gradually stopped. Toxemia followed shortly and death resulted in 3 days.

Experiment 6. The same milk preparation was fed but the injections were begun with .098 gm. per kilo. This experiment was followed by little reaction and the results were good.

Carter summarizes his experiments by stating that: Skimmed milk, peptonized for 1½ hrs. may be fatal when injected subcutaneously and that hypodermic injections of meat peptones and alkali albuminate are not feasible because of their great toxicity and the tendency to local necrosis. He feels, however, that meeting the full nitrogen requirement is possible by the injection of skimmed milk, peptonized 1½ hours and given in gradually increasing doses. The great toxicity of hypodermic injections of protein makes subcutaneous feeding rather a questionable procedure to be resorted to only in emergency. The use of aseptic serum or ascitic fluid, up to 400 c.c. daily is the preferable protein to inject for maintaining in part, the nitrogen balance. In hypodermic injections it must be remembered that slow injection is necessary for complete absorption. If the fluid is injected rapidly it may be, for the most part, excreted by the kidneys.

Intraperitoneal.—This method of artificial feeding has not been of practical use. Few experiments are found in the literature and nothing of practical value is reported. The injection of a foreign substance into the peritoneal cavity is too serious an undertaking to allow of feeding by this method. Serum and glucose have been introduced intraperitoneally, but the results have not warranted consideration of this method. There are few cases where the aforementioned methods will not be found feasible and their use is far less hazardous.

Cutaneous Application.—This method of feeding by inunction is applicable only to infants. Cod liver oil rubbed into the skin in the axillæ and the groins is absorbed to some extent but only a small part of the required intake may be supplied in this manner.

Full credit is due M. G. Peterman for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER XLVI

CARE OF THE BOWELS AFTER OPERATION OTHER THAN GASTROINTESTINAL

By Willard Bartlett, St. Louis, Mo.

The subject of pseudoileus has been adequately treated, it is hoped, in the chapter on ileus; hence no attention will here be paid to distention, gas pains, etc.

We must divide the surgical convalesence very distinctly into two periods so far as reference to this subject is concerned. The earlier of these has to do with the time that the patient is in bed on a restricted diet, and in other respects is leading an abnormal existence. The second period may be defined as that which begins when the patient gets out of bed and resumes to a certain extent the tenor of his customary existence, though somewhat modified it may be to suit hospital conditions.

During this early period the care of the bowels is not infrequently left to the patient's own discretion in all but the best conducted hospitals, strange as this statement seems. Only one grade better is the plan, which many readers will recognize at a glance, of leaving the whole matter to the judgment of a more or less experienced nurse, and while it can not be said that the care of the bowels is often one of the vital factors in the convalescence, still it is important enough, especially if diarrhea be present, for the operator or at least his house surgeon to have full control of it, and surely no cathartic should be given in a hospital without an order emanating from a medical source.

It is impossible to formulate any general rule governing this subject, and here, as in many other departments of postoperative treatment, one must individualize. This is true with reference not only to the individual needs of patients, but it will be readily admitted that various surgical procedures entail widely differing treatments of the intestinal canal. So it comes about that the best type of hospital interne will await indications before proceeding in the individual case. This is particularly true of the early convalescent period, since during this time one can readily imagine a state of depletion existing in many a patient which would render any exhausting procedure, such as vigorous catharsis may be, highly inadvisable. So little food is ingested during the few days which succeed a major surgical operation that the need of catharsis on this ground is customarily exaggerated, I am sure. Of course, we will presuppose the patient has been subjected to the ordinary preparatory measures. On the other hand, one can imagine the subject to have been brought to the table in an emergency, and then postoperative bowel movement no doubt becomes more urgent than would otherwise be the case, though here again one must not fail to individualize. The procedure is, unfortunately, not often thus. Every operator will remember frequently having been waylaid in the corridor by a solicitous relative who states that the sufferer's bowels have not moved for so and so many days, or the nurse will ask whether she may not, on general principles, give a dose of castor oil, or the patient, who has no local or general complaint pointing to the bowel, will want to know what our hospital rule is with regard to cathartics. The line of least resistance is for the medical attendant to tell the nurse to give the patient a cathartic, leaving the choice to her, or if he is not quite so careless, he will suggest an enema without any further consideration of the individual's needs.

Of course there do arise *general* evidences of the need of a bowel movement. They are not easy to put into words, but may be stated in general as abdominal discomfort, tenesmus, lack of appetite, rise of temperature, and a general ill feeling which the patient is unable to more accurately define. Where the symptoms are distinctly *local,* no matter what their nature, a digital or even possibly a proctoscopic rectal examination is to be made in every instance, something which under the circumstances is, I am convinced, rare outside of the leading hospitals. One who does this for the first time will be surprised to note the frequency of fecal impaction, a strictly local affair, which can be best remedied by local mechanical measures, and for which no doubt a cathartic is very frequently carelessly given.

In order to establish the need for bowel movement, one who is inclined to individualize will be interested when confronted by the man who has several watery stools a day when he is in perfect health, as well as by the woman who for years has gone about her normal pursuits with never more than one movement a week. That the needs of the two differ greatly goes without saying, and this is no less true after a surgical operation than before. It is commonly stated, and with a certain degree of truth in many instances, that a patient's bowels are not likely to move while he is in bed. However, I have been considerably more sanguine about this matter since being recently called to treat a patient who had not been off his back for fifteen years, and who, according to his own statement as well as that of his attendant, had not missed a normal daily bowel movement in all those fifteen years. A few experiences of this sort makes one less likely to indulge in generalities, and incline him rather to the line of individual reasoning. Of course this does not mean that nearly every patient confined to bed will go without help as far as the bowels are concerned. However, it does indicate that the needs of each and every one are entitled to a special consideration. To be perfectly fair, I will state a circumstance in marked contrast to that just related. The high temperature of 107° was noted in a young lady who did not seem to be very ill. She stated that her bowels had not moved for a week, and that under similar circumstances she had been affected in this way on other occasions. A cathartic was given, and we were all astounded, after her bowels moved in an hour or two, to find that her temperature had returned to the normal. Nothing further developed in explanation of the phenomenon; hence one is forced to the conclusion that there must have been the relation of cause and effect between constipation and fever on the one hand, as well as between cathartic and result on the other hand.

One is not to be unreasonable on this point and urge that no regard is due the lower digestive tract of the patient confined to bed, but on the other hand there are weighty enough reasons for seeing to it that the bowels do move after operation when occasion requires. Not only are the indefinite general symptoms above outlined to be relieved, but it is distinctly a physician's duty to see that a difficult movement is made easy, for the very same reason that he will endeavor to spare the patient a violent effort of any other kind. There is perhaps nothing worse for a convalescent patient than a great increase of intraabdominal tension, especially should this be continued for any length of time. One has but to keep in mind the pain in the wound which is occasioned in this way, to say nothing of the fact that cerebral apoplexy occurs frequently in elderly individuals at stool. Pulmonary embolism is distinctly favored by any increase in intraabdominal tension, provided, of course, that there be thrombosed veins in any part of the abdomen from which a fragment can be torn loose. Local evidences of undue strain of this particular kind consist in the appearance of blood in the stool, the formation of hemorrhoids, and not infrequently the appearance of prolapse in varied degrees. The duration of these manifestations will depend upon whether or not the causal condition is transient or permanent.

Granted, now, that the need for bowel movement has been established, we take up in general the question of how this shall be brought about. As is perfectly well known, most cathartics exaggerate the muscular activity of the entire intestinal tract. On the other hand, x-ray studies have demonstrated that the food is in a few hours carried into the colon, much of it into the lower end of that viscus,—this, of course, in the absence of mechanical obstruction. Does it not, then, seem logical to attack the lower, rather than the upper end of the bowel under such circumstances? This would seem so, and for a still further patent reason to one who has been operated upon and who has had experience with a large dose of castor oil before really recovering from the nausea, depression and pain attendant upon a major surgical procedure. I do not know of any way in which one can detract more from the psychic and physical comfort of an individual, sick or well, than by giving him a large dose of the nauseating oil, which is so universally employed under circumstances now discussed. Hence, are we not at least justified in seriously considering the matter, especially in view of the x-ray knowledge referred to above?

There are *prophylactic* measures which in many individuals with special predilections render the use of any remedial measures unnecessary. There are those in whom a cup of coffee or a cigar will invariably cause a movement of the bowels soon after they are enjoyed. Others find that they become constipated only when deprived of beer or some of the other malted drinks, while the employment of fruit juices is universally valued. One can hardly think of a patient who is given anything at all in the mouth who can not tolerate the three classes of fluid just mentioned.

Suppose, now, that prophylactic measures have not availed, may we not, before attacking the intestinal tract directly, with reason have recourse to the various nonmedical procedures which under the conditions of normal life are of value in accentuating the intestinal functioning ability? I refer here to massage of the abdomen, directed particularly to the colon and applied, of course, in the line of peristalsis. This can be quite conveniently done by the patient himself, if not too ill and provided there is not a wound of the abdominal wall, by running a heavy ball about over the anterior abdominal wall while lying on the back. Many individuals are not hindered by reason of their malady from going farther than this and indulging in quite a variety of light gymnastics while in the recumbent or semiprone position.

Suppose that none of the measures detailed up to this point have been of any avail and there are cogent reasons why the bowels should be caused to move. Knowing that practically all of the food has reached the colon, I have not in recent years used a general cathartic, unless for some very especial reason which lack of space here forbids, but have resorted uniformly to *enemas,* and must say that the results have in general been much more satisfactory than was the case in my earlier experience of another kind. But before taking up the various forms of enema in detail, we must proceed to disabuse ourselves of the idea that there is any difference between a low and a high enema. The painstaking nurse will ask, as soon as an enema is ordered, whether or not the operator wishes it given high or low. No such distinction, however, can be made at the present date by those who are familiar with Soper's x-ray work now universally accepted which shows that a tube passed into the rectum merely curls up if any attempt is made to introduce a length of it greater than that of the ampula. There are fluid substances without number which may be employed in the form of an enema. It has been the writer's practice in recent years, at the suggestion of Dr. Soper of St. Louis, to use in an adult 3 ounces of a saturated solution of magnesium sulphate, because this is the one chemical substance harmless in nature which relaxes the musculature of the sigmoid and thus most readily lets the intestinal contents out. Soper believes that contracture in this limited portion is the principal feature which we have to combat in postoperative lower intestinal spasticity. Some patients are quite readily affected by mere injection of a moderate amount of warm water, while in others soap suds very readily produce the same results. Often a few ounces of some cheap oil, like cottonseed oil, is very pleasant and effectual, and I have often found that a teaspoonful of alum dissolved in a pint of water will bring about very marked peristalsis, although it is quite probable that this may seriously damage the mucous membrane of the bowel. Hence, I have not used it in recent years. Where there is any objection to a large quantity of fluid, it is my practice to make use of an ounce or even two ounces of undiluted glycerine. This is almost sure to start peristalsis, although this has sometimes been exaggerated and rather painful in nature.

Of course, an enema of whatever nature is most transient in its effect. Hence it may often be well to accompany its use by the administration of simple *mineral oil*, which, by lubricating the lining of the bowel (this being nonabsorbable), tends to maintain intestinal motor function after the effect of the enema has worn off. Patients vary greatly in the effect of mineral oil. One may begin with a half ounce administered four times a day, and decrease or increase as the individual need indicates. I have seen many patients in whom four ounces a day were required, and others who could get along with half an ounce or an ounce equally well.

Certain cautions may be well observed by the individual who has never had experience with mineral oil. It is a most elusive fluid and can not be very accurately controlled by every one. It is not wise to pass gas with impunity after taking it, unless one happens to be so situated that a flood of oil does not matter particularly. Many a patient has thought flatus to be escaping and later found his clothing saturated with oil, or discovered that he was actually sitting or lying in a pool of it. It awakens no peristalsis, and in consequence gives no warning of its impending escape.

Mineral oil is most heartily and unreservedly recommended by me. It is the only substance of medicinal or semimedicinal nature which I give by mouth as routine as an aid to intestinal motor function. I have not seen any difficulty where properly used, although I am willing to admit that some others consider it to possess only a moderate value.

So much for the early period of a patient's convalescence, when he is probably in the recumbent position and relatively quiet in bed. If the bowels are to move at all, we will have had in this period to resort in many instances to some artificial aid. But let us now suppose the individual to be up, and the *second period* of his recovery to be commenced.

It seems now nothing less than a mistake, to put it mildly, for the surgeon to indulge in a regime of cathartics which may lay the foundation for future chronic constipation. The upright position, especially at stool, will now be of inestimable help to the patient. Furthermore, he should be encouraged to resume the habit of a lifetime with reference to going to stool at a certain hour, and as a matter of course the character and quantity of food most calculated to favor normal bowel activity can now be better indulged in than was the case when in bed. As he begins to exercise, he will also find without perhaps recognizing it, that the use of voluntary muscle tissue exerts a directly stimulating influence upon the unstriped musculature of the intestinal tract.

Diarrhea.—As has been shown in preceding paragraphs, constipation may play a subordinate role in the convalescence of a surgical patient. On the other hand, diarrhea may be the leading symptom of some pathologic condition which terminates fatally. Hence the extreme importance of considering this phase of the subject along with the other. It is wholly illogical to talk about treating diarrhea when it appears as a postoperative manifestation. One must diagnose the cause, a matter frequently as difficult as the treatment is easy, provided accurate indications can once be established. There are here so many possibilities, as stated by the gastroenterologists, that the natural limitations of such a chapter forbid us even mentioning all of them. We will, however, take up in some detail the four varieties of diarrhea which are most frequently observed after a surgical operation.

Nervous.—Nervous diarrhea may appear after an operation as well as before it in the neurotic type of individual, who will admit having been subject to it. The nervous upset caused by the operative procedure, as well as the circumstances antedating and following it, are surely enough to bring on one of these explosions so characteristic of a certain type of individual. The remedy is the same as that employed at other times. It consists first of all in an exercise of will power and self-control on the part of the individual, aided by the use of sedatives and more liberal feeding than would be employed in patients of any other type suffering from hyperperistalsis.

Fermentive.—Fermentive diarrhea is not common among patients who are carefully fed as a part of the postoperative convalescence. However, when it does occur, it should not be difficult to diagnose, and is best treated by large, warm enemas given slowly to the patient in such a position that the water may find its way up into the colon and wash out any decomposing material which has not already been spontaneously ejected. If the paroxysms of pain be very violent and the circumstances of the case permit, a long-continued, warm, relaxing tub bath is of great value. Opium suppositories of 1, 2, or 3 grains may be needed to secure rest and comfort. Such an upset is to be followed by *starvation* within the limits of such a patient to endure, and when feeding is recommenced the carbohydrates should be given distinct preference, since they, as a matter of course, do not decompose with the same virulent effect as do the albuminous substances.

Stercoral.—Stercoral diarrhea from the mechanical irritation of the colonic mucosa is dependent upon the presence of hardened feces, coproliths, or foreign bodies. The diagnosis is here made by digital proctoscopic or x-ray examination, and the remedy consists, as a matter of course, in the removal of the offending substance. This in one instance has necessitated, in my own hands, the opening of the sigmoid after laparotomy, and the removal of an enormous fecal stone. In another I was obliged to correct the position of a heavy uterus which dropped back upon the rectum and rapidly reproduced the same condition repeatedly in that viscus. It never recurred after the uterus was definitely out of the way.

Septic.—Septic diarrhea is a distressing symptom of a grave surgical complication. It appears in such a variety of surgical conditions and is of such comparative frequency as to deserve much more extended mention than is here possible. It will usually be recognized by the fact that it accompanies other symptoms of a septic nature, and will of course be treated not only symptomatically by the use of opium derivatives to the extent needed for its control, but the original focus, if it can be discovered, must of course not be neglected. For the direct control of septic diarrhea I have been in the habit of using 1 or sometimes 2 drams of paregoric immediately following every bowel movement in excess of one in twenty-four hours. Where this has been objectionable to the patient, I have used suppositories containing 1 or 2 grains of powdered opium immediately after every movement in excess of one in twenty-four hours. It does not seem reasonable to lay down any other fixed rule for the administration of opium products than the one just referred to, since the frequency of the bowel movements varies so greatly in the different individuals that no other procedure has been found to suit the requirements of all cases.

Dr. Stuart McGuire presents these instructions to every patient suffering from *constipation* when he leaves the hospital:

I. DIET

In general the diet should be coarse and bulky, containing especially the fibrous parts of vegetables.

On arising drink one or two glasses of hot or cold water.

Breakfast: Fruit, raw or cooked, except bananas; oatmeal; cream; corn bread, Graham bread, or bran biscuits; plenty of butter; eggs, except hard boiled; molasses or honey; coffee. Milk affects individuals differently; your own experience must guide you in the use of this article.

10 A. M., drink two glasses of water.

Dinner: Soup; fish, oysters; meats; chicken or turkey; any vegetables, but especially coarse vegetables, such as string beans, spinach, cauliflower, celery, lettuce, cucumbers, tomatoes, asparagus, salads with oil dressings; corn bread or Graham bread; butter, fruits; and desserts with or without cream.

4 P. M., drink two glasses of water.

Supper: Breads of the kind indicated; butter; chicken; oysters; fish; eggs; molasses or honey; vegetable salads, desserts with or without cream; coffee.

On retiring, eat dried figs, prunes or dates and drink one glass of water.

II. EXERCISE

A moderate amount of out-door exercise should be regularly taken, but not carried to the extent of profuse perspiration.

III. LAXATIVES

Consult your doctor. No one laxative will prove efficient indefinitely. All lose their effect and have to be changed. When it is necessary to use any, the best are compound licorice powder, cascara, senna, and mineral oil. Glycerin suppositories and soap suds enemas also have their place.

IV. HABIT

It is far better to regulate the bowels by food, water and exercise than with medicine. But it is better to use laxatives or enemas than to fall into the habit of constipation. Have a regular time to go to the closet, and acquire the habit of having an action at this time. The habit is not formed quickly; it may take months. But once formed, it will greatly improve your health.

CHAPTER XLVII

TREATMENT OF POSTOPERATIVE RETENTION OF URINE AND CYSTITIS

By John R. Caulk and Harry G. Greditzer, St. Louis, Mo.

Retention of urine, following surgical operations, occurs with a variable frequency, depending in a measure upon the nature and site of the operation, the anesthetic used, the temperament of the individual and coexisting pathologic conditions other than those to which the surgery was directed. Though it is not a common postoperative attendant to the general run of surgical cases, it happens frequently enough to promote a thorough understanding of its cause, and particularly of its treatment, since if improperly handled such serious consequences may ensue.

Postoperative retention occurs more frequently after rectal, perineal and gynecologic surgery. It has been shown that catheterization is necessary in from 4 to 18 per cent of the cases following labor, and as high as 23 to 25 per cent following major gynecologic surgery. The percentage is made high by the interposition operation for prolapse and extensive operations for cancer of the uterus. The large majority of hemorrhoid operations require catheterization. The more frequent operations in general surgery, such as gall bladder, appendix, and hernia operations are attended usually with a very small percentage of postoperative retentions, such retentions often being due to a complicating stricture, prostate or dormant tabes. A considerable number of individuals have what might be termed temporary retention, these usually void spontaneously and do not require catheterization. Taussig showed that in the normal postoperative cases following gynecologic operations spontaneous urination occurred on an average of twelve hours. However, quite a number of the patients went from 16 to 33 hours.

Effects of Anesthesia. It has been pretty definitely established that patients operated on under local or spinal anesthesia empty their bladders at a shorter interval and are less apt to have retention than patients who have been subjected to a profound general narcosis. Furthermore, the length and depth of the anesthesia seems to be a factor. It has also been observed that patients who have required large doses of morphia and sedatives are somewhat more prone to retentions. Neurotic individuals are more prone to postoperative retentions than are the phlegmatic ones. The cause of the retentions is usually put down as a reflex, and often this is the case, yet there are many patients who suffer postoperative retention who are included in this category, who in reality have an explosion of some organic central nervous system disease, or mechanical obstruction at the neck of the bladder. Such cases, if not transitory, should be cystoscopically investigated for such complications.

Treatment.—The average patient will void in from 8 to 12 hours after operation. Should they not void at the end of 12 hours, measures must be instituted for the relief of retention, especially if the patient shows symptoms of a full bladder, either subjectively or by objective findings, namely, the bladder dullness above the pubis. Should the patient be comfortable and show no signs of retention, he may be given a longer period. In the latter case he may be allowed to go either until he has a desire to urinate and can not or until the bladder seems distended. They must not be allowed to go so long as to produce marked overdistention of the bladder, with deleterious effects on its wall, or suppression of renal function. Should a patient begin to void in small amounts and continue to do so, one should be alert to the fact that a full bladder is frequently behind such a performance.

The methods of treating postoperative retention of urine are numerous. In the transitory and evanescent type, most any one of the simple measures will usually suffice, whereas in the protracted retentions a catheter will usually be required. Simple measures which are most currently utilized, are the employment of hot applications, such as hot water bags, hot stupes to the suprapubic region, hot enemas, and turpentine enemas about a dram to a quart; changing the patient's position, such as propping him up in bed, and even if the case permits, allowing him to stand. This latter measure when permissible, will often suffice to relieve a stubborn retention. Massage of the suprapubic region, as advocated by some is not very successful and often contraindicated. Pituitrin has been used in recent years with varying success. Ebeler found it extremely effective, as did Jaschke, but other observers have met with considerable failure. The introduction of drugs or air has been advocated by some. Braasch in 1903 proposed introduction of 20 per cent boro-glycerin with the hopes of stimulating bladder contractions. Waldstein used soap glycerin bougies, and

Taussig proposed the intravesical insertion of air. Glycerin and its derivatives have been effective in numerous cases; but as they are irritants, they are liable to harm the already indisposed bladder mucosa and lead to cystitis. I can see no excuse for any of these methods if a catheterization can be properly done. Should these measures prove ineffective, catheterization is the next resort, and here a word of warning needs to be issued. Under such circumstances catheterization must be done extremely carefully because the soil is fertile for bacterial growth. Since there is retention and usually bladder wall trauma with interference to the circulatory and nervous mechanism, catheterization should be executed under the strictest asepsis, as infection is likely to occur. When properly done, such an infection should be extremely rare.

Catheterization of the Male.—Catheterization of the male from a urological standpoint is seldom properly done by the average interne in the hospital. Great care is taken in the scrubbing of the hands, the wearing of gloves, and the adornment of the patient with sterile towels, and equal care is taken in the sterilization of the catheter, but the more important, and indeed the one important feature of catheterization passes neglected, namely, the thorough cleansing of the meatus and anterior urethra by swabbing and lavage to eliminate the bacterial flora from this region, which though not pathologic in their normal habitat, may be extremely so when put into the deep urethra and bladder. This one point of cleansing the anterior urethra should be more thoroughly taught. The choice of catheter depends in a great measure on the individual operator. As a general rule I should say that a woven silk gum coude catheter is far preferable to any other instrument. It is usually easier to pass, and gentleness is the keynote in catheterization. It is certainly less liable to become contaminated during manipulation than a soft rubber catheter, and the silver catheter is seldom the instrument for a novice who usually has to do the catheterization. In passing a catheter the inexperienced often becomes alarmed at the normal spastic contraction of the external sphincter. When one reaches this region with the tip of the catheter, firm pressure should be made and not a to and fro fishing motion as is so frequently done. The spasmodic contraction of the sphincter will shortly be broken by firm pressure. It is extremely essential not to inflict trauma, as this is the one important factor in the production of infection. Should the retention be due to a latent stricture, as is very often the case, urination may be produced by moderate dilatation with filiforms and followers, or soft woven bougies. Stricture is occasionally mistaken for spasmodic contracture of the external sphincter or obstruction at the neck, and unnecessary trauma made by repeated attempts at the passage of the catheter. This mistake should not be made if one will gauge the distance from the meatus, as most of the impassable strictures that offer such confusion are located at the bulbomembranous junction well in front of the bladder neck, and usually at a distance of about six inches. Should the retention be due to a prostatic hypertrophy which has suddenly become engorged following operation, a woven silk gum coude catheter is the instrument of choice. If this will not pass, one will usually succeed with either a bicoude or silver prostatic catheter.

In the female catheterization is more simple, and should be attended with far less trauma. As females are usually catheterized by the nurse, every hospital should give thorough instructions in the routine catheterization to the nurses. Here again it is extremely important to thoroughly cleanse the meatus and the surrounding lips. The choice of catheter lies between the female silver catheter with a rubber connecting piece, and a woven catheter. Glass catheters which are so frequently used are extremely dangerous. I have seen within the last few years quite a number of instances of glass catheters having been broken in the bladder. A soft rubber catheter is more difficult to pass, and it is extremely difficult to prevent contamination of its distal end. Here again gentleness is paramount. After catheterizing the patient, whether male or female, the bladder should be thoroughly washed with an antiseptic solution, and a small amount of the solution allowed to remain in the bladder; or it should be instilled with 25 per cent argyrol, or 1 per cent silver nitrate. This administration of an antiseptic we believe is extremely important and is almost an insurance against infection if the rest of the procedure is properly executed. In a urological office or clinic, patients may be catheterized for weeks or months without the slightest sign of infection.

Very frequently one catheterization is all that the average postoperative case will require. There are some, however, who demand repeated catheterization before normal urination is established. In such instances nitrate of silver may provoke evacuation. Should retention be at all protracted, some mechanical or neurological obstruction must be looked for, and this corrected by proper measures. In case catheterization is impossible, and this should be extremely rare, suprapubic puncture may be done. Suprapubic puncture is done much more frequently than is necessary. Even in cases of retention from pronounced grades of prostatic obstruction there is not one case in a hundred that can not be catheterized. As a matter of fact I have never seen a case that required suprapubic puncture or cystotomy unless it were for ruptured urethra or impassable stricture and, of course, the former would have no bearing on postoperative retention.

Treatment of Postoperative Cystitis.—In this brief discussion on the treatment of postoperative cystitis there will be no attempt to give a detailed description of the exact etiologic factors, the paths of infection, or the various pathologic changes. We shall concern ourselves entirely with the ordinary type of acute inflammation which occasionally develops during the convalescence of a surgical patient.

The three factors in the production of cystitis are retention, trauma, and bacteria. Various grades of retention are extremely frequent, both in the male and the female. There is an entire lack of appreciation of this fact with reference to the female. So many women have small amounts of urine retention in the bladder from various causes. This retention is often exaggerated and sometimes made complete after the administration of an anesthetic or operative manipulations in the vicinity of the bladder. Trauma of the bladder wall, particularly in pelvic operations is very frequent indeed, much more so than is usually thought. If one cystoscopes a bladder following some of the simplest pelvic operations, there will be observed a diffuse, extensive submucous hemorrhage throughout the base and posterior wall of the bladder. It is easy to see how this, by lowering the resistance of the bladder wall and interfering with the mechanical emptying capacity, could, in association with retention, play a responsible part in the production of bladder infection. The third factor, the active factor in bladder inflammation, is the presence of bacteria. We know that bacteria are constantly being excreted through healthy kidneys and pass out into the urine. In a normal untraumatized, unobstructed bladder they make their exit without molest, but with such an attractive medium as stagnant urine they find a fertile field for growth. This, of course, is not the only method of entrance for bacteria into the stagnant bladder, as they frequently enter through the lymphatics, either from the bowel, or from the pelvis, for instance in pelvic inflammatory disease, or possibly they may ascend through the urethra or through the blood stream, so that a bladder inflammation may easily develop without the entrance into the bladder of a catheter. However, with catheterization there are practically always inserted numerous organisms. It has been shown that under the strictest asepsis innumerable bacteria are introduced into the bladder through instrumentation. In the normal bladder this is without untoward effects.

The lighting up of an old chronic infection of the kidney, such as pyelitis, pyelonephritis, or a recrudescence of chronic bladder infections, may be responsible for cystitis following operation.

There are to be differentiated from a true cystitis two somewhat frequent complications which may occur postoperatively. Trigonitis or trigonal hyperemia in women, and prostatic and posterior urethral inflammation and irritability in the male quite frequently produce symptoms which are identical to those caused by cystitis. A catheterized specimen of urine will serve to differentiate the two, as in the latter the urine is clear and uninfected. Another symptom complex which may occasionally puzzle the attendant until urine has been obtained is the occasional frequent, painful urination, which is seen with a bladder which does not empty itself. This is quite common in women past middle life. Just recently we saw a patient who was supposed to have a cystitis from her symptoms. She was passing urine very frequently and suffering excessive pain. A catheter relieved a two quart retention of urine and the patient's symptoms immediately subsided. This suggests a very careful suprapubic percussion and a urinalysis.

Symptoms.—A cystitis will usually make its appearance within the first week of the postoperative course, generally the third day. There is noticed an increased frequency and burning on urination, often terminal pain with a sense of dissatisfaction after the act of urination, and the desire to make another attempt. Often a suprapubic pain and a sense of pressure, or bearing down pain in the lower abdomen, occasional low backache, also occasional hematuria, which in the acute cases is usually terminal, are present. With such symptoms one may be quite assured that cystitis has developed, even though catheterization has not been done. A catheter specimen of urine should be carefully examined, one will usually find pus and bacteria, and usually the colon bacillus. There is seldom fever in an acute cystitis unless there is some coexisting lesion either in the urethra or kidney, so that if a patient with these symptoms has fever one should certainly suspect a renal infection. The urine is usually acid as a result of a colon bacillus infection. Occasionally it is alkaline due to the proteus group, the micrococcus urea or the staphylococcus.

Treatment.—As a preface to our remarks on the treatment of acute cystitis it may be stated that almost invariably a frank cystitis under appropriate treatment will be promptly relieved within a week or ten days. This may be stated as a golden rule. Should it not respond one must direct attention to some other cause, such as an associated vesical, prostatic and seminal vesicle lesion or an inflammatory kidney. This must be borne in mind as so many individuals are treated for weeks, indeed months, without improvement to their bladder condition, while its running-mate infection, either above or below is progressing to unnecessary, and often damaging developments.

The treatment of cystitis may be classified as follows:

Prophylactic		
Medical	Hygienic	
	Dietetic	General
	Therapeutic	Local
Surgical	Removal of Cause	
	Curettage	Suprapubic
	Cystostomy	Perineal
		Vesicovaginal fistula

Concerning prophylaxis, most has been said under the paragraph devoted to urinary retention. The important things to observe are care during surgical manipulation to prevent injury to the bladder wall, and in the case of retention following operation, gentle, careful cleanly catheterization followed by the administration of an antiseptic into the bladder, and vigilance to protect the bladder from overdistention in an individual who is voiding, and the general administration of copious amounts of water, urinary antiseptics, and careful attention to the bowels. Should a cystitis develop, medical treatment, either general or local, usually suffices to promptly cure the postoperative type, and it is seldom that one sees a case necessitating surgical interference, and then only in cases of complicated cystitis, that is one in association with stone, tumor, diverticulum, or some other abnormality.

Medical Treatment.—During the acute symptoms patients should be kept quiet, instructed to drink freely of water, at least a glass or more an hour, in order to make the urine bland. Alkaline waters are given by some, but plenty of good hydrant water is sufficient. Patients should be kept on light, nutritious and substantial food, avoid all condiments, and should not be allowed alcohol in any form. Mild laxatives such as cascara, phenolphthalein or small doses of saline in the morning, are essential. Local heat either through hot compresses, hot-water bag, or the electric pad, to the suprapubic region are often helpful. Hot rectal, or vaginal douches are also extremely soothing. The medical applications are given for a twofold purpose: to relieve the distressing symptoms and to combat the infection. For relief of the pain and tenesmus, administration of alkalies is often exceedingly beneficial. Bicarbonate of soda, 10 to 30 gr. three times a day, in case of an acid urine, is helpful, as it lessens acidity, produces a mild diuresis, and has a slight antiseptic property. It also possesses the advantage of not disturbing digestion. The alkalies used most frequently are potassium citrate, potassium acetate, and liquor potassæ. Combinations of these drugs which are more or less standard are the following:

℞	Pot. acetate	
	Tinct. hyoscyam	āā oz. 1
	Water	q.s. oz. 6
M.	Sig. Two teaspoonsful in a little water after meals.	

℞	Liquor potassæ	oz. 2
	Ext. hyoscyam	gr. x
	Tinct. opii camph.	oz. 1
	Syr. acaciæ	oz. 2
	Water	q.s. oz. 6
M.	Sig. One tablespoon in glass of water after meals.	

For tenesmus and extreme pain, anodynes are often necessary. A most satisfactory one is a suppository containing ½ gr. powdered opium, ¼ gr. extract of belladonna, or a similar combination containing double strength. The bromides are often beneficial. Triple bromides, ammonium, sodium and potassium prepared in an effervescent wafer, is a very satisfactory remedy. Occasionally if the symptoms are hyperacute, morphine and codeine may be required. To combat the infection, internal antiseptics, coupled with local applications to the bladder are necessary. The most efficacious internal antiseptic is urotropin for an acid cystitis. It is often equally efficacious in alkaline cystitis if the urine can be rendered acid by the administration of an acid-producing drug. Other antiseptics in common use are salol, benzoic acid, acid sodium phosphate, helmitol, hetralin, borovertin, cystogen, and certain of the balsamics, particularly sandalwood oil. In gonorrheal cystitis the balsamics are more applicable. In staphylococcus and streptococcus infections, urotropin is preferable in conjunction with benzoic acid or acid sodium phosphate. Acid sodium phosphate is unquestionably the most valuable drug for acidifying the urine. Urotropin should be given in doses from 30 to 60 grains a day, preferably after meals and at bedtime in conjunction with 20 gr. of acid sodium phosphate. Various other drugs, such as hetralin, borovertin, cystogen, uraseptin, methylene blue and others have been extolled as having superior qualities, but none possess the efficacious effect of the substantial urotropin. Of the balsamics, which, as has been said, are particularly effective in gonorrheal cystitis, the oil of sandalwood stands preeminent. It should be given in 10 minim doses, three times a day after meals and at bedtime. Numerous preparations of sandalwood are on the market, namely, gonosan, arrhovin, santyl and arrhoel. The allied drugs are supposed to be free from production of disagreeable gastric symptoms. We believe, however, that there is very little difference in this respect.

Demulcents are not as frequently used today as formerly. Such drugs as buchu, uva ursi, triticum repens, flaxseed tea and corn silk, while soothing, are seldom used in urology today. Their popularity was gained by their somewhat quieting effect in acute and chronic cystitis lasting over long periods, in uninvestigated cases of urinary infections.

Local Treatment.—Many cases of acute cystitis without retention may be cured by hygienic and dietetic means, and internal medication. The majority, however, are hastened in their cure by local applications to the bladder itself. In the acute bladder infections, instillations are preferable. After catheterizing the patient, instillation of 25 per cent argyrol to the empty bladder is most trustworthy. Even though argyrol is supposed to have very little antiseptic quality, it is remarkable how quickly it will clear up an acutely inflamed bladder. Protargol, 1 to 2 per cent is used by some, but it is often badly borne on account of its irritating quality. Nitrate of silver is seldom tolerated in the acute bladder, but it is the master of all in chronic infections. It is surprising how quickly relief may be obtained by a few instillations of argyrol, and as has been previously stated, the average cystitis will clear up within a week or ten days. Irrigations are not desirable in acute bladder inflammation, as they disturb the bladder rest by distention and are not as efficacious. In the subacute or more chronic cases irrigations of potassium permanganate 1 to 6 to 8,000, boric acid 2 to 4 per cent and bichloride, 1 to 50,000, silver nitrate, 1 to 5,000, and hot saline solution are most beneficial.

In case of alkaline cystitis which is a very stubborn, intractable and painful type of bladder inflammation, the problem consists in rendering the urine acid in order that the alkaline producing organisms may not live. Various acid irrigations have been given, but usually without effect. The most helpful, and at times almost magic treatment for such conditions is the intravesical injection of Bulgara bacillus. Make an emulsion of 4 to 6 tablets, which are prepared by various drug houses, and inject through a catheter into the empty bladder and have it retained. This should be repeated twice daily until the urine is rendered acid. If the cystitis is not complicated by a kidney lesion, the cure will be prompt. Even in cases of incrustation, we have seen a rapid solution of the incrusted material within forty-eight hours, and a prompt restoration of normal bladder function in a very short period. In case the kidney should be involved, the administration of acid sodium phosphate in conjunction with the Bulgara bacillus to the bladder will be necessary.

If a cystitis is protracted and has not abated within two weeks, one is certainly dealing with a complicated lesion, either a kidney lesion, some associated bladder phenomena, such as stone, tumor, diverticulum, bladder neck obstruction, either mechanical or neurologic, or one of the many types of chronic cystitis, namely, the hemorrhagic, ulcerative, vegetative, or bullous type. The treatment of these will depend on thorough cystoscopic investigation and study, and has no bearing on the postoperative treatment commonly termed. Therefore the surgical treatment of cystitis need not be considered in this discussion.

CHAPTER XLVIII

THE TREATMENT OF WOUNDS

By Willard Bartlett, St. Louis, Mo.

Historical Considerations.—The healing of wounds, naturally, forms the oldest chapter in the history of surgery. Marchänd[1] is authority for the statement that Hippocrates, more than two thousand years ago, recognized two varieties of wound healing; one with the formation of pus, and the other without it. Celsus realized that wound fluids were derived from the blood, while the influence of Galen was so marked upon the development of this subject, that it persists to the present day. He knew, for instance, that certain wounds heal without the loss of substance, whereas others take the contrary course, thus laying the foundation for the use of the terms, "first and second intention." His treatise, Ars Medica, contains a number of principles to which we adhere today. His influence is distinctly the most important one that has come down to us, from the remote past, and was about all that it furnished up to the discovery of the circulation, the invention of the microscope, and the inception of experimental study.

The Middle Ages produced practically nothing of value on wound healing, so the second period of development, which has lasted to the present time, may be said to have commenced with Schwann's discovery of the cell, which was developed by Virchow in 1855, in his aphorism "Omnis cellula e cellula." A natural enlargement of the idea came down through the discoveries of Pasteur, which were applied to practical surgery by Lister, and marked the beginning of the antiseptic era, which was later to develop into our present aseptic regime.

Principles Which Underlie Wound Healing.—The study of the subject may be classified in many ways. Perhaps as good as any, for general purposes, is a division of wounds into those uniting by "first intention," that is, without loss of substance, and those which unite indirectly after loss of substance has been compensated by granulation tissue which has changed into scar, this last procedure being known as "healing by second intention."

It can be definitely and clearly stated that there is no such thing as *absolutely perfect asepsis.* It is said that positive cultures of infective bacteria can be obtained in over 50 per cent of fresh surgical wounds, and in fact, it is safe to assume, at least, that no wound is ever made and closed without a germ getting into it, but for practical purposes, the tissues themselves take care of a reasonable number, in consequence of which, closed wounds usually heal without pus formation. It is quite a different matter with wounds which heal by second intention. These latter invariably become infected, and it is important that proper means for the drainage of their products be furnished, if the patient is to be spared the toxic effects of bacterial growth.

Bier[2] was the first to grasp the importance of furthering the efforts of nature towards healing wounds in her own way, as shown by the invention of his hyperemia treatment. He noted, very early, that cyanotic lungs are rarely tuberculous, and rightly concluded that some of the substances in the dammed back blood, act as germ destroyers. He applied this deduction to wound treatment, intensifying redness, heat, and swelling, by constriction or cupping, "passive or active hyperemia," with the happiest results.

One can gain a clearer and more comprehensive idea of the mechanics which aid repair, by reading John Hilton's[3] little book on "Rest and Pain." This admirable dissertation was written a long time ago, but will well repay a careful perusal, so long as men continue to practice surgery.

The *direction* of an incision in certain parts of the body, has very much to do with the nutrition of the wound edges. A fairly high percentage of tissue loss has followed almost every method of flap making, which contemplates complete closure after radical breast operations, although in our own experience, we have had uniformly satisfactory results, since using a transverse elliptical incision, proposed by Stewart.[4] This example can be multiplied almost indefinitely; no one, for instance, would consider making a crescentic scalp flap, with the base upward, and other illustrations of this rule or precept will no doubt present themselves to the reader's mind.

Wounds located in *regions* particularly well supplied with blood and lymph, heal much faster than those so placed as to receive a minimum amount of these vital fluids. Thus, it is a matter of common observation, that tissues of the face, for instance, heal much quicker than do those in other parts of the body. For the same reason, the skin more quickly repairs than do the deeper tissues, as exemplified by fat, muscle, fascia and bone.

The *extent* of the cut also is a factor in wound healing, which can not be overlooked. After long incisions, the greater surface exposed to infection, and the impossibility of perfect immobilization, are some of the causes for the slow reparative processes frequently seen in such instances.

The importance of this observation is well borne out by the behavior of long wounds in the aged. In them, tissue repair is much slower than in the young, and failure to remember this has often resulted in long drawn out convalescence, due to the slow healing of a needlessly long incision. In view of the fact that these patients should be restricted as little as possible after an operation, careful attention to this detail will not only result in better wound repair, but also, now and then, be the means of saving a life.

The importance of having no *tension* on wound edges can scarcely be overemphasized; the mere fact (in the event this is not properly attended to) that the blood supply will be cut off and sloughing result, or stitches cut through, and wounds come open, is certainly more than sufficient cause to commend a most careful observance of this important matter. Incidentally, it should be mentioned that there must be no pressure by bandages or dressings on the flaps, else nutritional changes will ensue.

Among the *general considerations* to be observed, are ventilation, which not only makes the sick-room habitable, but also directly contributes to the patient's increase in tone, which, as a matter of course, must underlie every healing process. The effect of general conditions on local processes, was strikingly illustrated to us recently. An anemic girl had experienced a thyroidectomy, and the skin wound stubbornly refused to heal, for many weeks. She was put to bed in the hospital, and absolutely nothing done but to feed her up, and keep the granulations clean. Almost immediately a marked improvement was observed, and in a few days the skin edges had correctly approximated themselves.

We now and then see a large wound which has opened up spontaneously, although there is no sign of infection, and while it looks clean, yet no evidence of repair is apparent. This can practically always be attributed to the influence of one of the *dyscrasias* which prevent local reparative activity.

Weather and *temperature* are said to exert a very marked influence on wound healing, the hot, dry seasons and climates seeming to favor it, while those in which moisture predominates, apparently have the opposite effect.

Phagocytosis apparently is a matter of great importance in the healing of infected wounds. It has been determined by Steuber,[5] that cholesterin decreases this activity, while lecithin completely stops it. He states that a bedside determination of these two blood constituents is, therefore, of prognostic value.

Preexisting sepsis is a matter of *great* importance in this connection. On one occasion, we were compelled to open the abdomen of a patient who had just recovered from a severe influenza, with most disastrous consequences as far as wound healing was concerned.

An operation performed during the incubation period of any of the *exanthemata* is extremely unfortunate. In the experience of the author this influence was observed in two cases of scarlet fever, one case of measles and one case of variola. In each instance the wound became infected, in spite of every precaution. Surgical procedures undertaken in the presence of such diseases, carry with them the risk that dire consequences may follow, so far as the severed tissues are concerned.

Laboratory experimentation shows that pus infections of the skin, within an appreciable distance of the region to be operated, make it impossible to cleanse such regions sufficiently to prevent the growth of cultures. Therefore, patients with a localized staphylococcus infection, much more a generalized infection, or an extensive dermatitis of infectious nature, can hardly be prepared for operation with any assurance that infection will not be disseminated. *Chronic diseases,* such as tuberculosis, diabetes, arteriosclerosis, and syphilis, are particularly apt to cause delay in wound healing. We have seen this repeatedly in patients with marked hardening of the arteries, but after heavy doses of potassium iodide, the wounds in almost every instance rapidly closed. In none of these cases were we able to find any other explanation for the tissue inactivity. In patients suffering from syphilis, breaking down of any wound may occur. In large clinics, where the lowest class of patients are operated, mercury is given as a routine measure to prevent this so far as possible. Recently, a patient with a perfect history and negative physical examination was operated for hernia. The wound refused to heal, though there was no infection or any reason why it should be obstinate. The blood revealed a four-plus Wassermann. The patient was now put on antisyphilitic treatment, which resulted in the defect healing as though by magic.

The very *obese,* or those of generally *lowered resistance,* due to varying causes, present difficulties in wound repair, while the poor results obtained in the cachexia of extensive carcinoma are well known.

Germ carriers are naturally not good subjects, a matter which needs no further elucidation.

Among the more *uncommon causes* of faulty wound healing, is infection with the diphtheria organism, as reported by Zeullig.[6]

A special consideration must be given wounds of the mucous membranes. As a matter of course, none of them can be regarded as clean, hence they must be protected as far as possible. This will be taken up later in connection with the special regions involved.

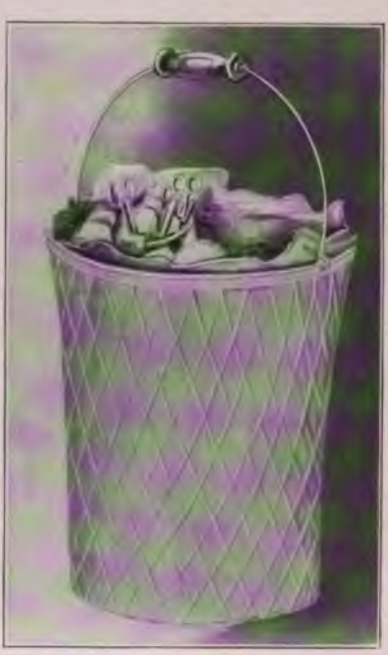

Fig. 55.—A convenient wire basket containing the necessary materials for dressing wounds. Used at Mayo Clinic.

Early Treatment of Aseptic or Closed Wounds.—After a surgical wound has been sewed up, we must see to it that it remains sealed against the entrance of germs, and is protected from every mechanical insult, until the reparative process is well under way. The form of dressing will be dictated by the region involved, as well as by a consideration of the wound discharges. In the vicinity of external orifices, heavy sterile vaseline, or a sealed dressing (collodion, varnish, paraffine, etc.,) is admirable as a protection against the possible ingress of the various secretions and excretions. In other parts of the body, the expected discharge of blood, serum, or lymph, from a clean wound, would naturally presuppose the immediate application of a sterile, voluminous, absorbent dressing.

When shall the *dressing* on a sterile wound be *changed?* This is a question which is difficult to answer in a general way, since individual wounds, as a matter of course, make individual requirements. It may, however, be stated for most patients, that an inspection of the dressing, or the patient's sensations of discomfort, or a glance at the temperature chart, or all three of these combined, will very readily settle the matter, (Figs. 55, 56 and 57.) Where no drain has been left in, and there is no cosmetic reason for the early removal of sutures, where the patient is comfortable and there is no marked rise in temperature or pulse, it is common in our

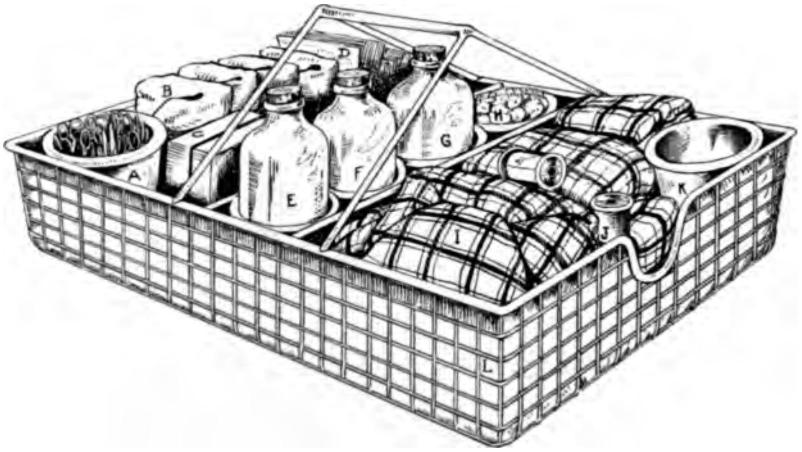

Fig. 56.—Large basket containing materials used in treatment of wounds.

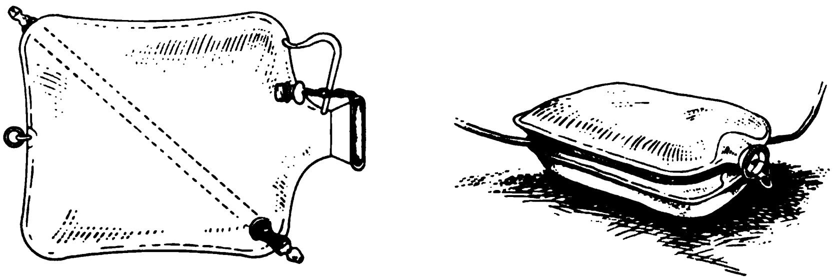

Fig. 57.—A water bottle which may be maintained at any temperature by means of a stream of water passing through it.

practice to allow the original dressing to remain in place about one week.

When shall a drain be removed after septic operations? Generally speaking, there is no reactionary hemorrhage after twenty-four hours, hence, a drain which is expected to conduct away blood can usually be removed at the expiration of this period. Clean wounds must often be drained for lymphorrhagia after the dissection of the inguinal, cervical, and other similar regions, but these drains must usually be left in place for several days, and be removed when the dressings no longer become soaked.

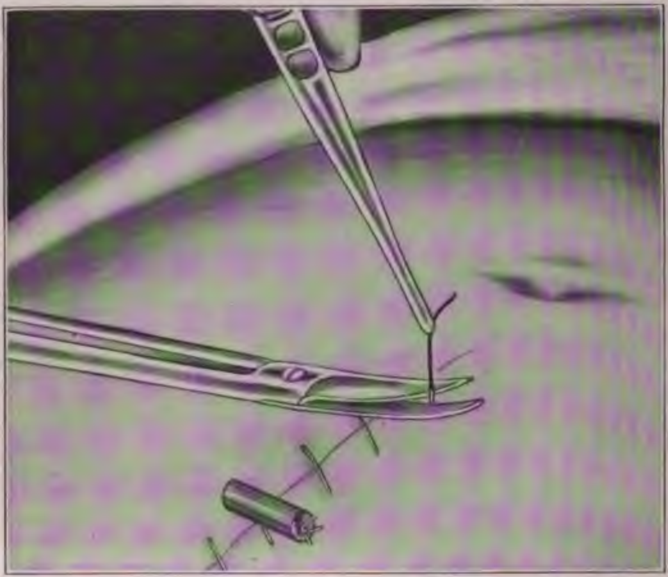

Fig. 58.—Stitch pulled up and cut through portion that was buried in skin.

Scars upon the face and neck are, as a matter of course, and if at all possible, to be avoided. In order that this "consummation, so devoutly to be wished" may be attained, it is necessary to pay attention to a number of details, among which may be mentioned the *early removal of stitches*, say in one or two days, if a deeper layer has been firmly sutured. This early removal of the stitches invariably prevents the unsightly stitch cross-marks which one so frequently sees on scars not so happily treated. In other parts of the body, we allow the skin stitches to remain about a week (Figs. 58-61.) Agglutination transpires within twenty-four hours, and after a week's time, considerable fibrous union is noted.

"Through-and-through" stitches are removed in ten, twelve, or fourteen days, according to whether the patient is quiet, provided they do not cut and become too painful; this latter contingency is however, unlikely to occur if the stitches have been run through thin rubber tubing or been tied over other material, which protects the skin.

Patients are, almost without exception, nervous and apprehensive of suture removal. In order to avoid, or indeed, eliminate this unnecessary strain as much as possible, we have often found it expedient to inform the individual that our intention is to remove the sutures the following day, and thereupon, to proceed immediately to that very step. In this way he is spared hours of uneasy and unhappy imaginings.

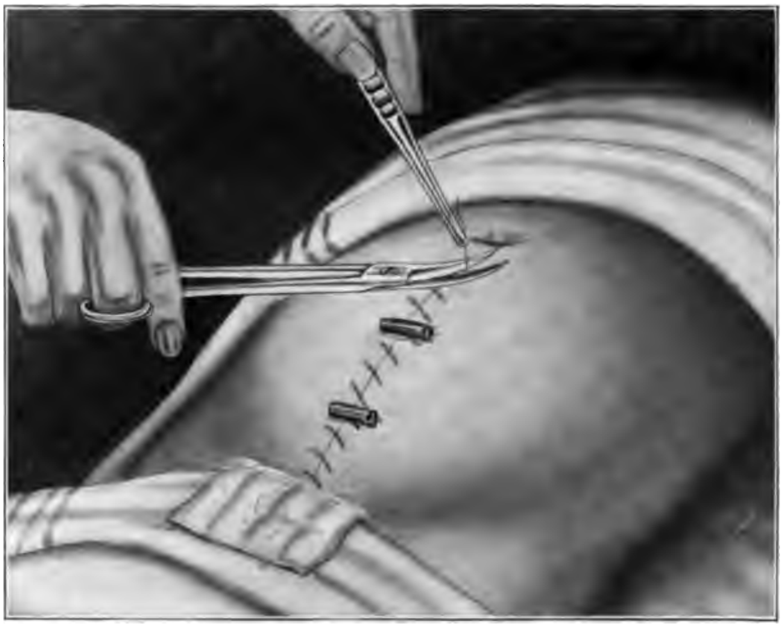

Fig. 59.—Dividing and removing superficial stitches.

Severe pain may some times be lessened by counterpressure on the skin while pulling upon the stitches.

If liquid fat, lymph or blood serum *collects* in a wound that has been tightly sewed up, it is advisable to spread the edges a short distance by thrusting forceps into the cavity and opening the jaws, after which, a strip of rubber dam is to be inserted. A few hours of this treatment will usually be found to be all that is necessary, and the drains may then be removed.

Stitch infections are painful, as a rule. They may be recognized by a circumscribed redness around the stitches, and naturally, they demand immediate removal of sutures, after which, they will usually heal spontaneously; although sometimes they may demand dilatation, and the insertion of rubber drains, when abscesses have formed.

Early Treatment of Infected or Open Wounds.—Too much can not be said regarding the importance of asepsis when employed to prevent us engrafting tetanus or other infections into already suppurating wounds. The treatment of infected wounds resolves itself into a comparison between forms of drainage as against antisepsis, which latter is certain to cause coagulation of the excretions. We consider the drainage of any open wound to be the matter of major importance, while the chemical destruction of bacteria, as formerly practiced, was not only of doubtful value, but indeed, harmful, since drainage was impaired.

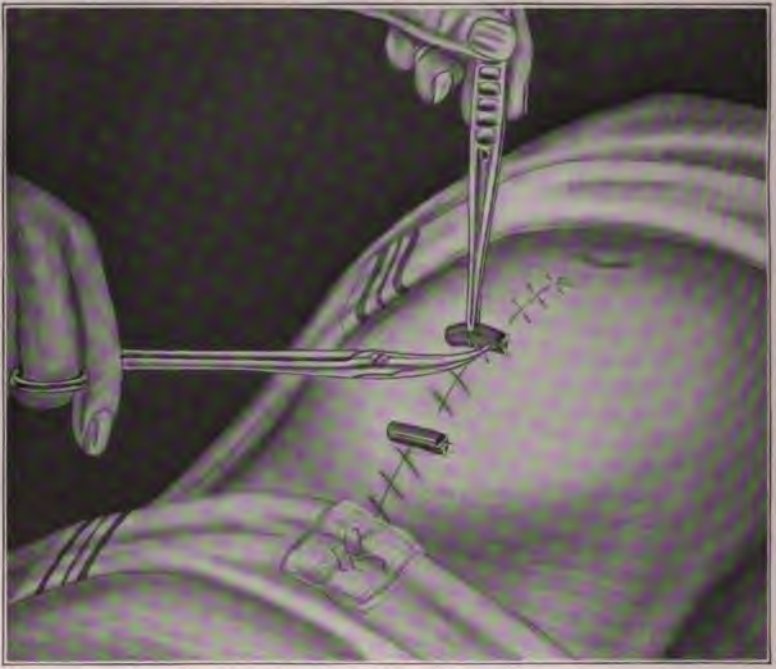

Fig. 60.—Method of removing stitch from beneath rubber cover of tension suture.

The use of hypertonic solutions of various sorts has been found to promote drainage, while in my own experience, glycerin (hygroscopic) (Figs. 62 and 63) has been the most efficient agent of this kind I have ever used. In closed dressings it depletes tissues rapidly, and gives immediate relief from pain. It is universal in its application, and although the cheaper grades contain sulphuric acid, and hence, are highly irritating, yet this may be readily ascertained and easily avoided. An excellent wet (Figs. 64-68) dressing is glycerin, peroxide of hydrogen, and distilled water, equal parts. We have used this for many years, especially where dirty wounds are to be cleaned up rapidly. An admirable dressing for painful granulating surfaces, is Una's Mixture, which is made after the following formula:

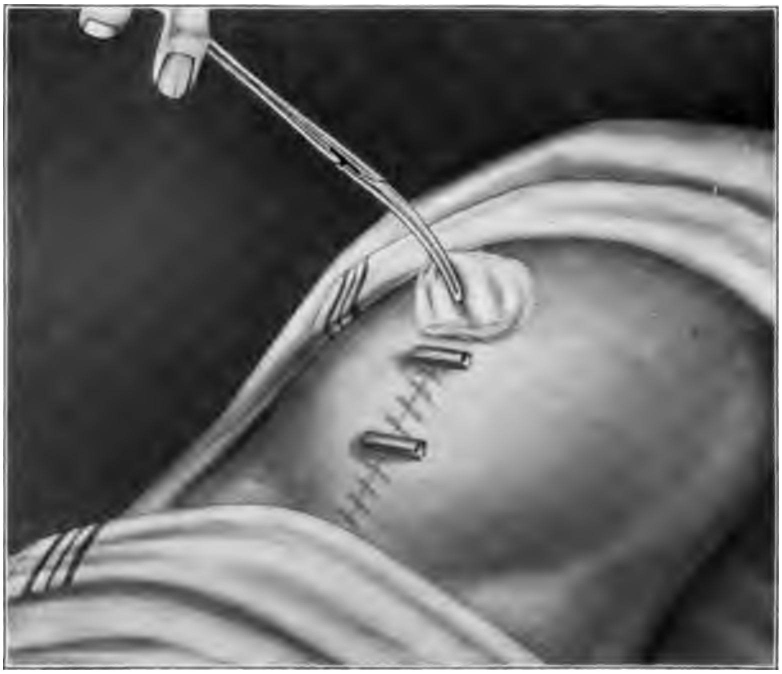

Fig. 61.—Cleaning the wound after stitches have been removed.

Amylum and Talcum, each	100 grams
Glycerin	40 grams
Liq. Plumbi subacetate, dilute,	200 grams

This is to be thoroughly shaken and poured on cotton to be covered with gutta percha, and changed every few hours. It gives a most delightful sensation of relief and cooling.

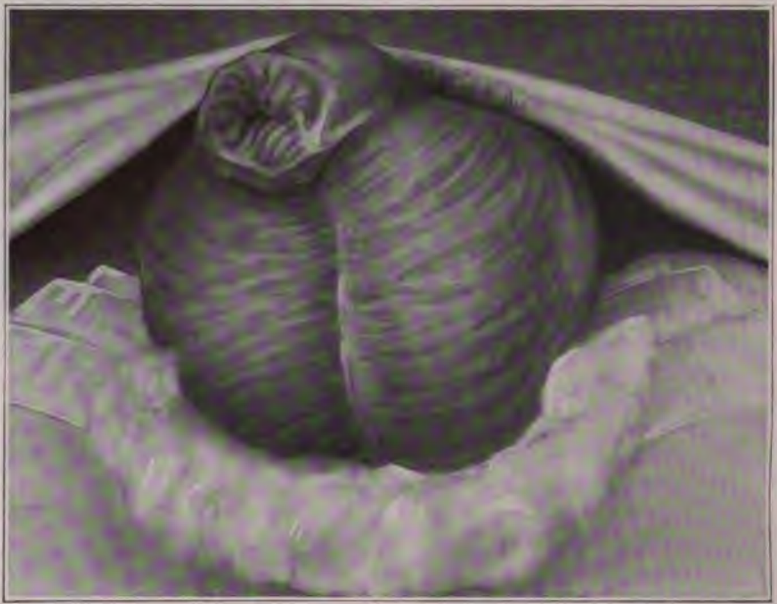

Fig. 62.—Acutely inflamed scrotum and penis to which glycerin pack is about to be applied.

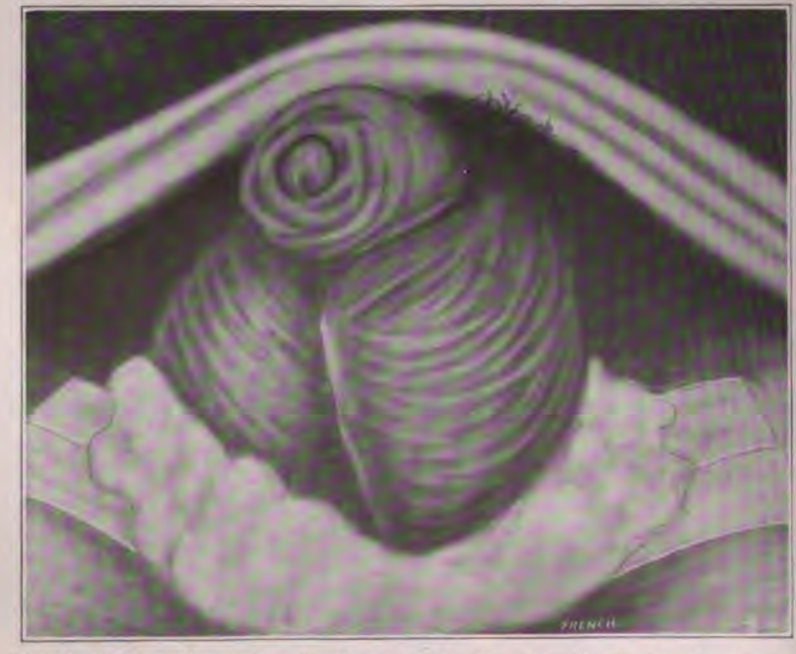

Fig. 63.—Same scrotum and penis after twenty-four hours' application of glycerin pack.

There can be no set rule for the frequency of changing wet absorbent dressings. This must occur as often as they become saturated or foul.

Ways of *keeping dressings in place* will be discussed under "Bandaging," and in other places in this book, but I shall mention just a few special devices here. Dressings for breast wounds may be attached to underwear. This applies to a less extent to other portions of the trunk, where gauze and cotton are not easily kept in place, and when patients experience, more or less, the discomfort caused by the slipping of the bandage. Adhesive plaster (Fig. 69) has been found very satisfactory for this purpose, as it holds the dressings immobile, neither is it necessarily removed at each dressing. The plaster should be cut in the middle and folded back when the dressing is changed, and adjoining ends be refastened with tape or safety pins (Figs. 70 and 71). In order that the adhesion may be perfect, all surfaces to which adhesive plaster is applied should be shaved and rendered absolutely dry, or hairy parts may be conveniently treated with a depilatory, the chief ingredient of which is calcium sulphide dissolved in water. Fenestrated adhesive plaster, which allows the escape of perspiration, is to be recom-

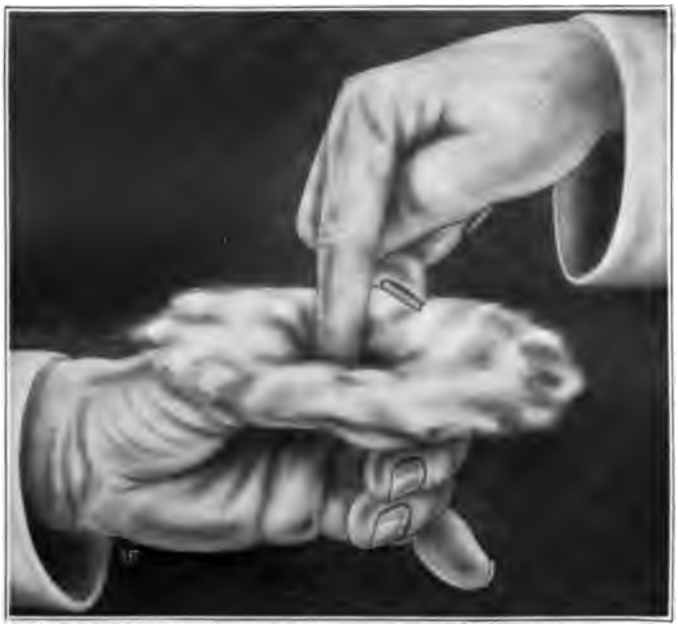

Fig. 64.—First step in making cotton pledgets.

mended in that it is more comfortable to the patient and less likely to cause itching and dermatitis.

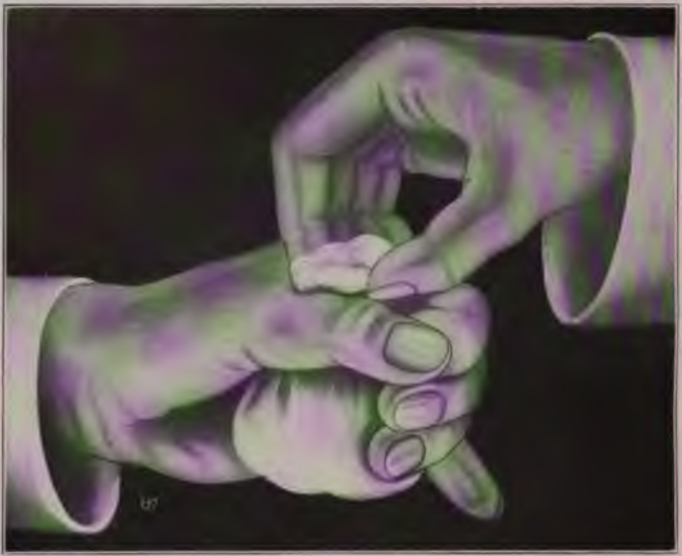

Fig. 65.—Second step in making cotton pledgets.

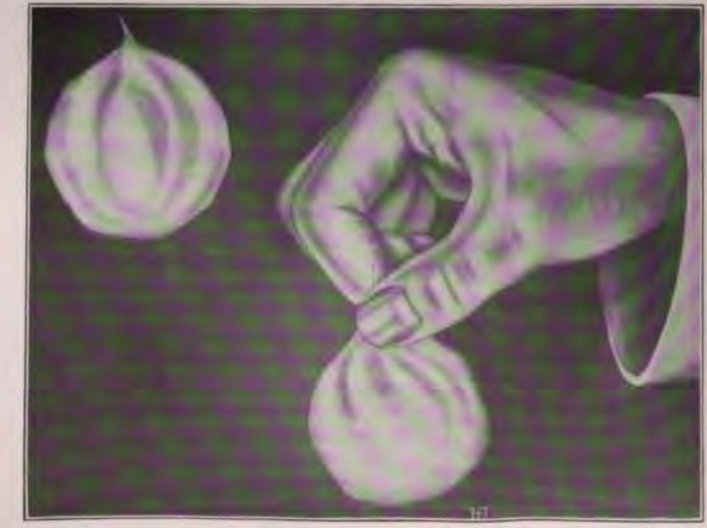

Fig. 66.—Third step in making cotton pledgets.

A sterilizing agent long lauded by German authors, is balsam of Peru. This is injected into wound cavities and applied on wound surfaces. Blumberg[7] conducted a series of the most thorough and exhaustive experiments in the use of this agent, and found it a most valuable one in the successful handling of fresh, primary, dirty wounds, as well as in cases where granulations were present.

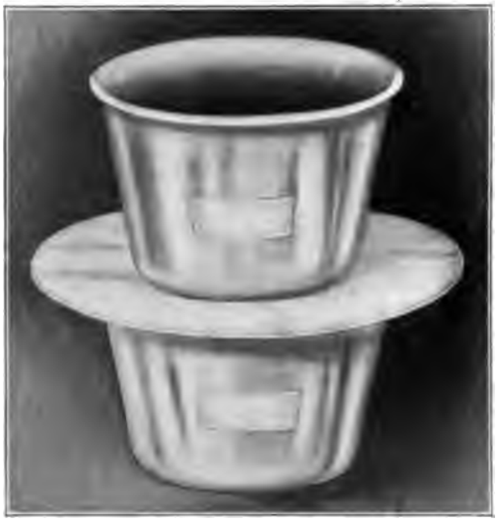

Fig. 67.--Small covered basins for holding antiseptic solutions. Used at Mayo Clinic.

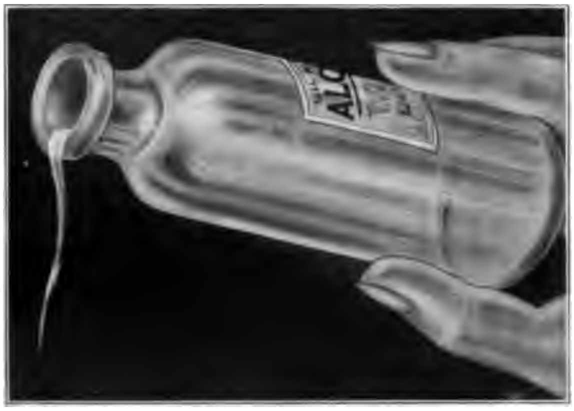

Fig. 68.—Washing lip of alcohol bottle before pouring the liquid on a cotton sponge.

Dakin's Fluid, a product of the present great war, is the sensation of modern times, so far as wounds are concerned. Dr. C. L. Gibson[8] returned from France, early in the Fall of 1916, and told us that the minority of the surgeons then working in France were enthusiastic over Dakin's fluid, while the majority thought unfavorably of it. Surgeons of the laboratory type claim wonderful results for it, while the eminent clinician in America will have none of it.

It seems that Carrel, who gives extensive personal care to many little details of treatment, uses the fluid with the highest measure of success, while Du Page, who has eight hundred beds at Le Pan, is equally successful, for the reason that he carefully follows the Carrel regime. With the exception of Dr. Henry Lyle, of New York, no one else seems to have followed out Carrel's technic in the entirety, and this accounts, in Dr. Gibson's opinion, for the fact that the fluid has not been more widely used with success. Gibson saw Carrell do the first dressings in a number of cases, where an infected compound fracture had been treated with Dakin's fluid, and then sewed up tightly. In not one instance was there a disturbance of wound healing. He also saw Du Page dress eighty compound fractures in four hours, without a drop of pus being apparent, many of these having been first treated with Dakin's fluid, before the wounds were sewed up.

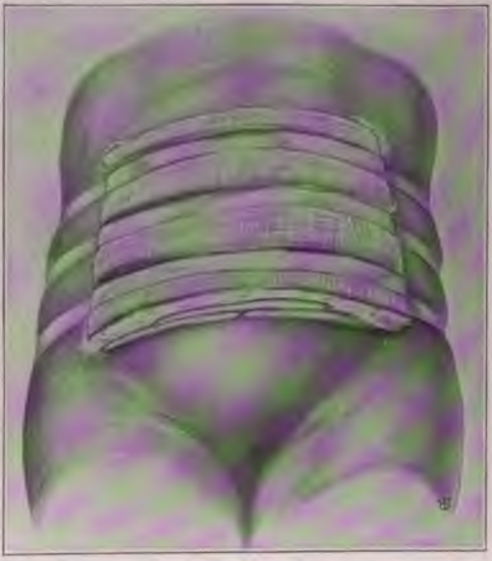

Fig. 69.—Use of ordinary adhesive for holding dressings in place.

In the early days of Dakin's fluid, the solution was not properly made, and proved to be too highly caustic, hence, it has been altered, the composition now being as follows, according to the so-called technic of Dr. Daufresne:

The solution of sodium hypochlorite for surgical use must be free of caustic alkali; it must only contain 0.45% to 0.50% of hypochlorite. Under 0.45% it is not active enough and above 0.50% it is irritant.

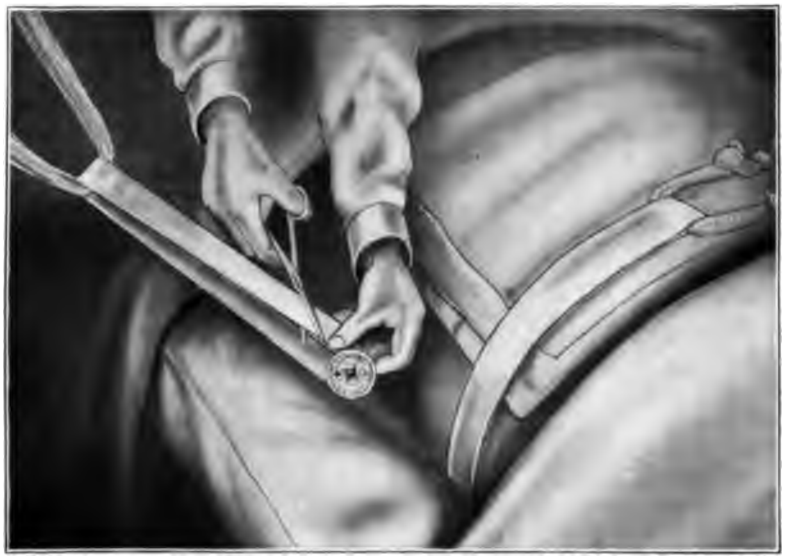

Fig. 70.—Attaching gauze tapes to adhesive.

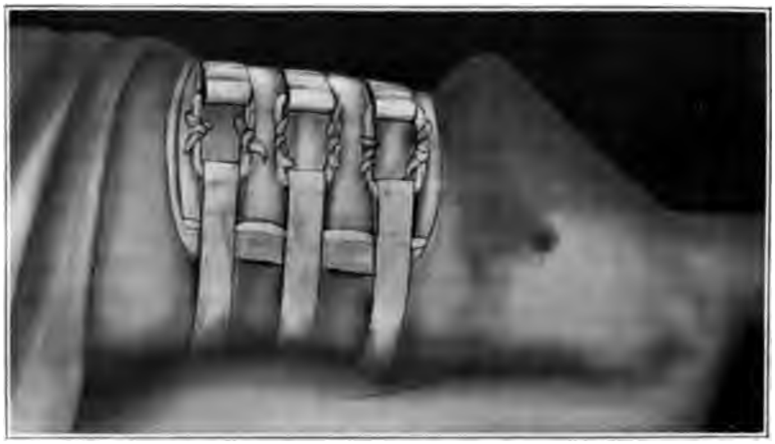

Fig. 71.—Gauze tapes tied so that adhesive does not have to be pulled off skin when changing dressings.

With chloride of lime (bleaching powder) having 25% of active chlorine, the quantities of necessary substances to prepare 10 liters of solution, are the following:

Chloride of lime (bleaching powder) 25% of Cl. act.	200 gr.
Sodium carbonate, *dry*, (soda of Solway)	100 gr.
Sodium bicarbonate	**80 gr.**

Put into a 12 liter flask the two hundred grams of chlorine of lime and five liters of ordinary water, shake vigorously for a few minutes, and leave in contact for six to twelve hours; one night for example.

At the same time dissolve in five liters of cold, ordinary water, the carbonate and bicarbonate of soda.

After leaving from six to twelve hours, pour the salt solution in the flask containing the macerated chloride of lime, shake vigorously for a few minutes, and leave to allow the calcium carbonate to be precipitated. In about one-half hour, siphon the liquid and filter with a double paper to obtain a good clear liquid, which should always be kept in a dark place.

Titration of Chloride of Lime (Bleaching Powder).—Because of the variation of the products now obtained in the market, it is necessary to determine the quantity of active chlorine contained in the chloride of lime which is to be used. This is in order to employ an exact calculated quantity according to its concentration.

The test is made in the following manner: Take from the different parts of the jar a small quantity of bleaching powder to have a medium sample; weigh 29 grams of it, mix as well as possible in a liter of water and leave in contact a few hours. Measure 10 c.c. of the clear fluid and add 20 c.c. of a 10% solution of iodide potassium, 2 c.c. of acetic acid or hydrochloric acid, then put, drop by drop, into the mixture a decinormal solution of sodium hyposulphite (2.48%) until decoloration. The number of cubic centimeters of hyposulphite employed, multiplied by 1,775, will give the weight *N* of active chlorine contained in 100 grams of chloride of lime.

The test must be made every time a new product is received. When the result obtained will differ more or less than 25%, it will be necessary to reduce or enlarge the proportion of the three products contained in the preparation. This can be easily obtained by multiplying each of the three numbers, 200, 100, 80, by the factor 425, in which N. represents the weight of the active chlorine percentage of chloride of lime.

Titration of Dakin Solution.—Measure 10 c.c. of the solution, add 20 c.c. of potassium iodide 1/10, 2 c.c. of acetic acid and, drop by drop, a decinormal solution of sodium hyposulphite until decoloration. The number of cubic centimeters used multiplied by 0.03725 will give the weight of hypochlorite of soda contained in 100 c.c. of the solution.

Never heat the solution and if in a case of urgency one is obliged to resort to trituration of chloride of lime in a mortar, only employ water, never salt solution.

Test of the Alkalinity of Dakin Solution.—To easily differentiate the solution obtained by this process from the commercial hypochlorites, pour into a glass about 20 c.c. of the solution and drop on the surface of the liquid a few centigrams of phenolphthaleine *in powder*.

The correct solution does not give any coloration while Labarraque's solution and Eau de Javel will give an intense red color which shows in the last two solutions existence of free caustic alkali.

In the treatment of a wound, a great deal depends upon the fluid reaching every little cavity, hence, four rubber tubes are connected to a glass apparatus (Fig. 72). These are closed at the outer ends, and perforated with many small openings, so the fluid injected through them is widely diffused. *The surface of the wound is kept damp but not flooded.* Irritation of the surrounding skin is prevented by the liberal use of vaseline on a cloth. The reservoir is held one meter above the wound, and frequently, six to ten of the glass connecting rods, previously mentioned, each equipped with four rubber tubes, are employed in a large defect. A very small dressing is used, just a layer or two of gauze, on which the glass connecting rods lie. This dressing is changed every day, and if all the pockets are reached, germs rapidly disappear from the wound. Matter which is obtained as a fresh smear, is taken and examined daily; in ten days or two weeks, the wound becomes sterile; when it remains sterile for about six days, the edges are trimmed with a scissors and the whole tightly sewed up.

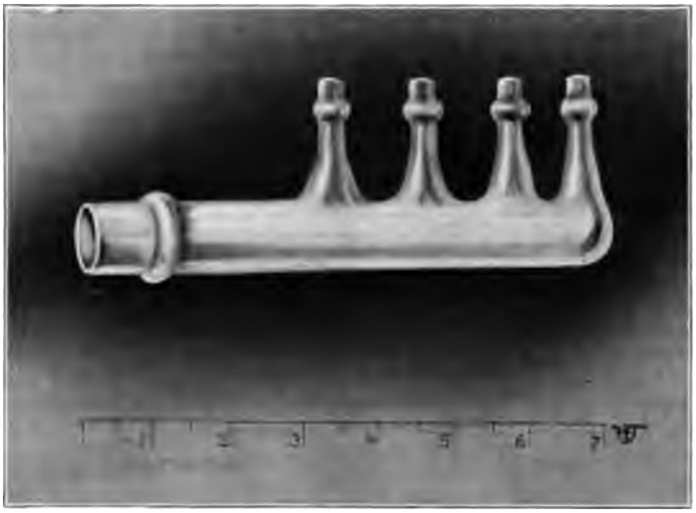

Fig. 72.—The Carrel-Dakin glass distributor.

Surfaces are prepared for skin grafting in the same way, and Gibson reports astonishing successes for it. He saw some such areas dressed four days after the grafting on granulations, and they were perfectly dry.

It may be added that Carrel considers the method complicated, at the present time, and is trying to produce a much simpler one. Dr. Lyle,[9] who has just returned from the front in France says: "The Carrel method of disinfecting wounds is based on the following conception: To render an infected wound sterile, it is necessary to employ a suitable antiseptic in such a manner that the chosen antiseptic comes in contact with every portion of the wound, that the antiseptic is maintained in a suitable concentration throughout the entire wound, and that this constant strength is maintained for a prolonged period. If these conditions are fulfilled, every wound will show its response to the treatment by the diminution and disappearance of its microorganisms. The chemical destruction of the microorganism of a wound depends on the difference of resistance existing between the tissues involved, and the bacteria present on their surfaces."

He summarizes his conclusions on this subject as follows: "The future course of the wound is directly dependent on the thoroughness of the first surgical act. This should be carried out under the strictest aseptic precautions and at the earliest possible moment. It consists of a thorough, methodical, mechanical disinfection of the wound with the extraction of all shell fragments, particles of clothing, dirt, etc.

"The Carrel method is not a continuous irrigation. It is not dependent on the miraculous power of an antiseptic, or on any one feature of the method, but on the combination of the whole. It is a method of sterilizing wounds by mechanically delivering an antiseptic of definite chemical concentration to every portion of a surgically prepared wound and insuring its constant contact for a prolonged period. The progress of the sterilization is rigorously controlled by the microscope. Gentleness, thoroughness, and attention to detail are essential for success. I firmly believe that the adoption of this method is destined to save many lives, to reduce the gravity of the mutilations, and allow the rapid return to the front of many men who would otherwise be lost to the service of their country."

In a recent personal communication, Dr. W. G. Fralick writes us: "The great impetus which has been given to the use of the Drs. Carrel and Dakin Hypochlorite in surgery, through widely published reports, would seem to warrant our giving to the profession the most intimate knowledge we have of their chemistry and bactericidal effects, together with technical reasons for a preference of a particular hypochlorite, for clinical use. My research work with the halogen compounds extends over a period of more than 15 years, and deals with methods of preparation, their chemistry and bactericidal action, together with their surgical application on deep and superficial wounds, intraperitoneally and intravenously; also their action and dissolving power on infected blood clots and necrotic tissue."

Hypochlorous acid, as a medium for wound treatment has received wide commendation; among others, Dalton[10] reports a series of fifty-seven cases, thus treated. The results obtained were uniformly excellent. Fraser[11] tells us that the solution has been used with inestimable benefit in gas gangrene, and in compound fractures, complicated by infection. Again the Medical Research Committee[12] of the Royal College of Surgery of Edinburgh, advocates the application of eusol, and praises its use in wounds which have become septic after certain operations, and considers that it has been proved nontoxic and nonirritating, as well as an efficient antiseptic.

The *specific* use of antiseptics is well brought out by Ochsner[13] when he writes that he believes our physicochemical experiments, biochemical studies, bacteriologic investigation and clinical experience are corroborative, and justify the following conclusions, viz: that osmosis is a purely chemical process; that boric acid, when applied to the surface of the body in a saturated aqueous solution, is absorbed in appreciable quantities by a process of osmosis similar to the process studied in the chemical laboratory; that, when used in cases of septic infection, it is most potent in reducing the virulence of certain pathologic bacteria; but, that in order to be effective, it must be applied in saturated solution, and finally, that when applied as above directed, in the early stages of septic infection, most cases will make a complete recovery without incision, without the loss of any member, and without permanent impairment of function.

He also states that he has come to the point where he looks upon this dressing as almost specific in streptococcus, Staphylococcus albus and citreous infections of the skin and cellular tissue, as well as in pemphigus, and that in order not to be disappointed in our use of boric acid wet dressings, it is important that we make a diagnosis as to the nature of the infection. As a rule this can be done easily, at least one can practically always say whether a case is one of malignant edema, tuberculosis, or impetigo contagiosa, and it is only in these three infections that boric acid is contraindicated.

Beck seems to have injected bismuth paste with good results (Fig. 73).

One of the most important recent innovations is well described by Dyes, who, in discussing the treatment of infected wounds says: Heat and moisture are essentially necessary for the growth and development of pathogenic bacteria, consequently tissue destruction is greater in moist, than dry gangrene. He calls attention to the fact that the Indians preserved their meats by placing the carcasses high above the ground and exposed to the air and sunlight. He also comments upon the fact that domestic animals rarely have suppurating wounds, and that these wounds are kept open and clean by constant licking. In conclusion, he remarks upon the successful treatment of burns by the open method, and mentions the remarkable results attained by Rollier by this mode of procedure in surgical tuberculous affections. The method pursued by Dyes is as follows: The patient is put to bed. A cradle (Figs. 74 and 75) is placed over the affected part, over which a mosquito netting is placed as a protection against flies and flying crusts. In some instances, a small electric fan is turned on the lesion, and kept going for from fifteen minutes to half an hour, four or five times a day. Only an occasional raising of the crusts, to allow the escape of serum or the irrigation of a stubborn area for a time, is permitted. An inert

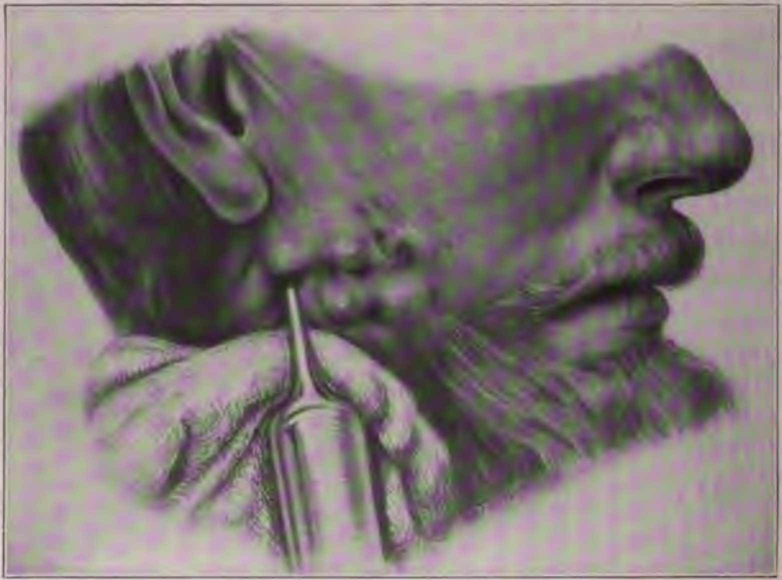

Fig. 73.—The injection of Beck's bismuth paste.

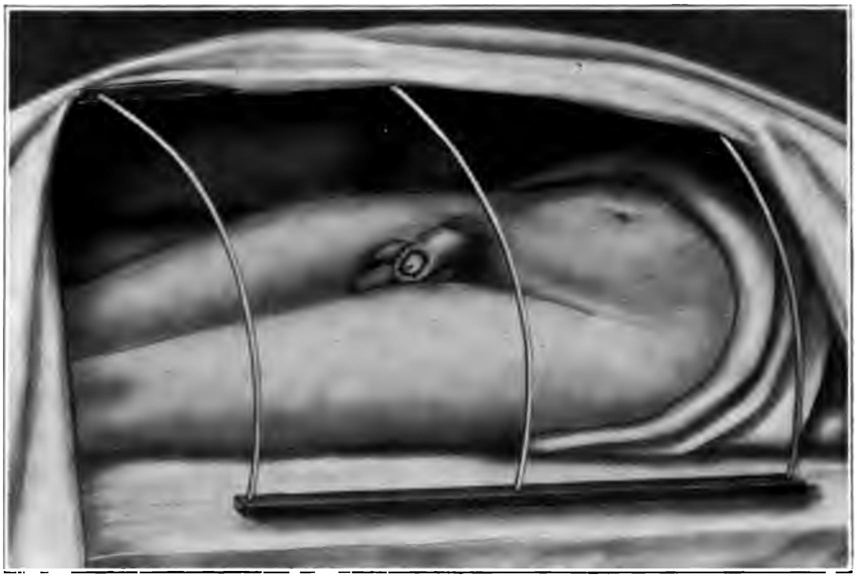

Fig. 74. A convenient cradle under which a large surface may be kept exposed.

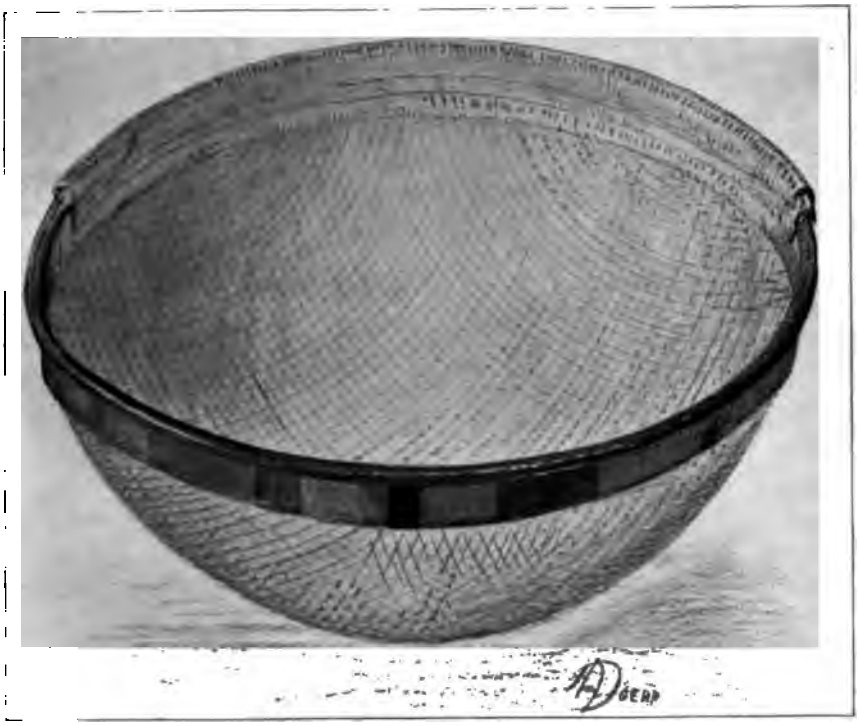

Fig. 75.—A small shield for exposing a small area.

desiccating powder is used at times, and in ambulatory cases, wounds are protected by a wire screen held on by adhesive plaster.

I have made extensive use of the method, and found it eminently satisfactory. The patient is comfortable, the surrounding skin stays healthy, much money is saved, as no dressing need be bought, and all in all, it has answered every requirement very well. I combined it with Crile's[15] electric light treatment and found the combination particularly applicable to the treatment of suppurating abdominal lesions, such as those of the appendix. Caput in 1914 first discovered that electric light would take the place of the sunlight in the healing of wounds. In fact, analysis shows the two rays to be similar. At the present time I am treating two fecal fistulas in this manner. The patient is far more comfortable, and indeed much better off than with voluminous dressings soaked with feces. The entire abdomen is covered by a cradle which supports the light and at the same time holds the bed clothes at a distance. In smaller wounds, I use an ordinary wire gauze strainer from a hardware store, as a protection, and am careful to see that there is an electric light near by, or that sunshine falls on them from a near-by window.

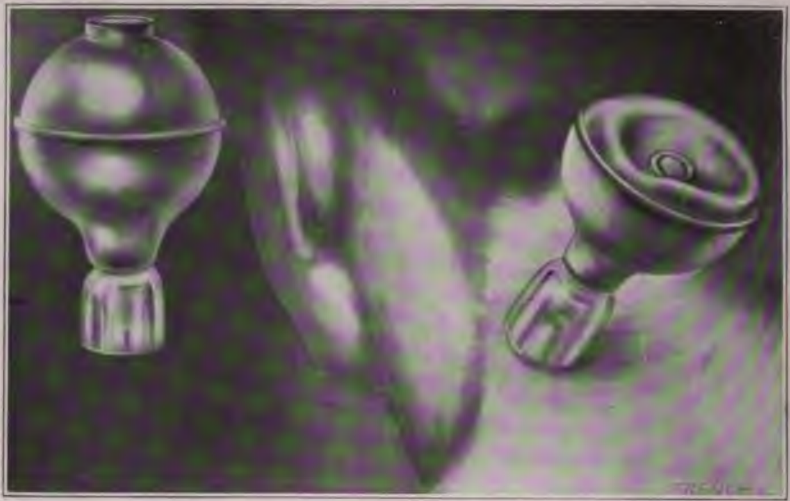
Fig. 76.—An automatic glass rubber cupping device.

There are certain infected wounds which are best treated by suction cupping. This will be found to relieve edema; it removes secretions, eases pain, and in general, facilitates rapid repair. Furuncles (boils) form excellent examples of this class of wounds. In a case which could not be aborted, but has had to be operated upon, if sufficient time has elapsed before the incision is made, the necrotic center of the lesion can be lifted out at once; but if it is not loose, gentle suction (Figs. 76 and 77) should be employed every hour or so, the wound being merely covered by a vaccination shield and exposed to the rays of an incandescent bulb, placed so close to it as to produce an agreeable degree of warmth.

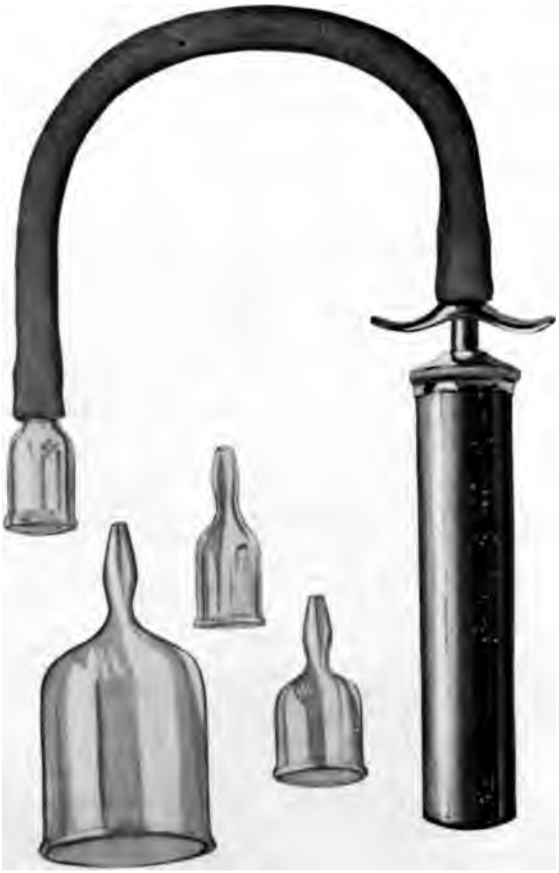

Fig. 77.—A positive suction cupping device.

A fifteen watt lamp gives a delightful sense of warmth, as the recent experience of the author has demonstrated, while the ordinary green metal household shade protects surrounding parts from heat and light. In a short time the necrotic center can be sucked out *in toto*, after which the defect rapidly granulates up, and no further treatment is needed than the occasional cleansing with alcohol to prevent the reinfection of the surrounding skin openings, and the protection of the wound with a vaccination shield.

Suppose the lesion is on the back of the neck, and any form of circular bandage be worn. Painful pressure and distressing massage of the lesion are unavoidable every time the head is turned. The patient endeavors, by using all of the neck muscles, to hold the field at rest, and very soon excessive local fatigue added, makes his lot still more unhappy. It may be further said that any form of dressing makes a pus poultice, and accounts in a great measure for the reinfections and for neighboring secondary furuncles; on the other hand, the growth of bacteria is hindered by the drying up of excretions from a wound exposed to the air.

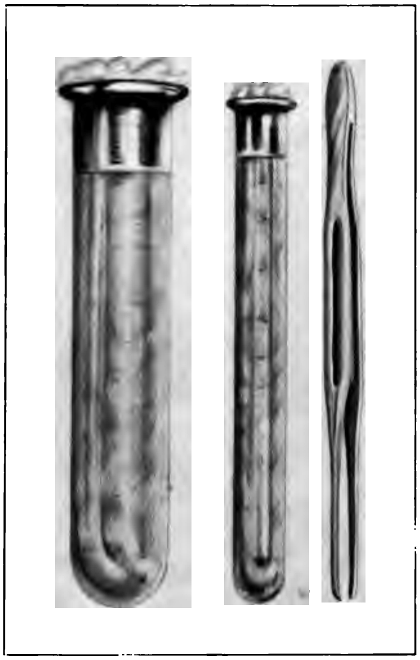

Fig. 78.—A convenient way of storing sterile gauze packing in glass tubes.

This treatment may be carried out by any intelligent member of a family or office force, which brings it well within the range of possibility for many men, without upsetting the ordinary routine of life. If carried out faithfully, with regard for every detail, it robs this distressing malady of its most serious features. The sort of "stock" affected by horsemen and golfers, can readily be worn over the vaccination shield, and the patient be rendered somewhat uncomfortable, though much more presentable, than is the case when an otherwise well-groomed man with a stiff neck, goes about minus collar and tie, with a surgical bandage where they should be.

The suction rapidly reduces the edema in adjacent muscles, with the consequent early disappearance of the stiff neck so characteristic of the condition.

Generally speaking, the *irrigation* of infected wounds has almost passed out of use. I vividly recall a case of axillary abscess, many years ago, which was treated by daily irrigation. The temperature rose to 104° within an hour after each treatment. The treatment was discontinued, but left a memory, never to be forgotten. Mention of daily *gauze packing* (Fig. 78) of defects is made, only to be condemned. It is not only highly painful, but at the same time, gauze retains the secretions and becomes foul. Where gauze (Fig. 79) must come in contact with granulations at all, it is perhaps well to consider Fisher's[16] suggestion that plain surgical gauze is unsatisfactory, where it adheres to granulating wounds, a disadvantage which is less troublesome if narrow mesh gauze is used. No particular advantage attaches itself to medicated gauze. (Figs. 80 and 81.) He considers that he secured the best results from the use of gauze impregnated with paraffine treated in the following manner: eight parts of paraffine mixed with two parts of white petrolatum and lanolin boiled for ten minutes.

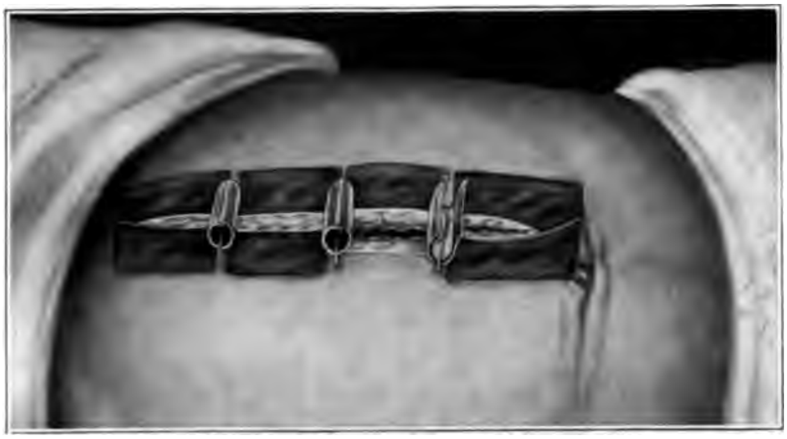

Fig. 79.—Granulations covered with gutta percha which protects them from gauze dressings which would otherwise adhere.

Drainage is well employed in the removal of lymph, liquid fat, blood or pus. The length of the period over which it is to be continued must be determined in each individual case. As to drainage material, I shall preface this subject by the brief warning, that this never should be gauze, as it does not drain. Neither do I advise glass tubes, as I have seen these break in the wound. A rubber tube (Fig. 82), if used, should be split the entire length, in order that fluid may run into it at any point, and the tube itself be withdrawn more easily, than one with holes, into which granulations have grown. A folded rubber dam makes an excellent drain, in that it causes no pressure, which is likely to result in decubitus. All drains should be sutured to the edge of the skin, or otherwise prevented from slipping into a cavity and being lost.

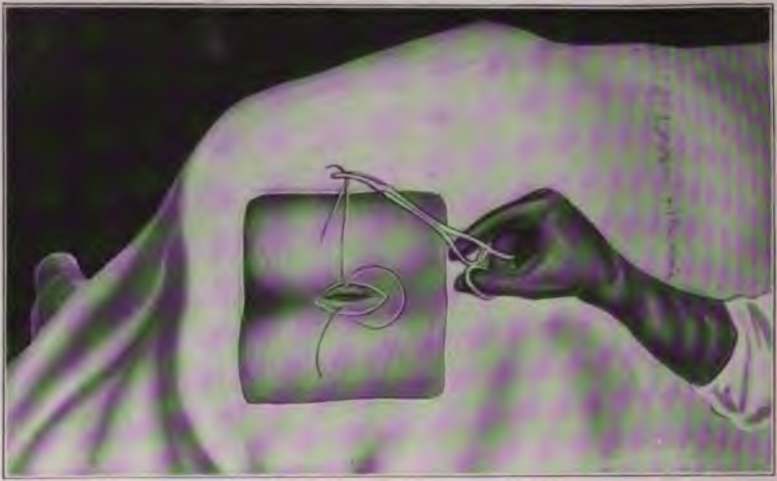

Fig. 80.—The insertion of stitches which are intended to hold gauze packing in place.

The drain opening should, of course, be placed at the most *dependent* site. It is well to remember that the posture of the patient can be altered to influence this. For instance, we frequently keep a patient on his face to facilitate abdominal drainage. Chaput,[17] for some time, has discarded tubular drainage, in pathologic cavities and replaces them by filiform drains. These consist of threads of varied caliber. The drainage is capillary and he considers *this* form of material much better than tubes, and says further, that they permit a more rapid recovery with an insignificant cicatrization. I distinctly favor through-and through drainage where it is possible to secure counter openings. The ends of the drain are fastened together, and hence, do not slip out, thereby insuring greater comfort for the patient.

Isuardi[18] would shatter time tried tradition, in opposing the employment of drainage in the treatment of septic wounds. Of two hundred wounds treated by him in the Reserve Hospital of Vercelli, thirty-two were very grave and septic, most of them being fracture wounds. He is of the opinion that drainage and incisions disturb the progress of the reparatory process, and that drains, whether gauze, rubber, or glass, are foreign bodies, which irritate the tissues, and give a harboring stronghold and breeding place to microbes. Isuardi must at least be mentioned for the sake of completeness.

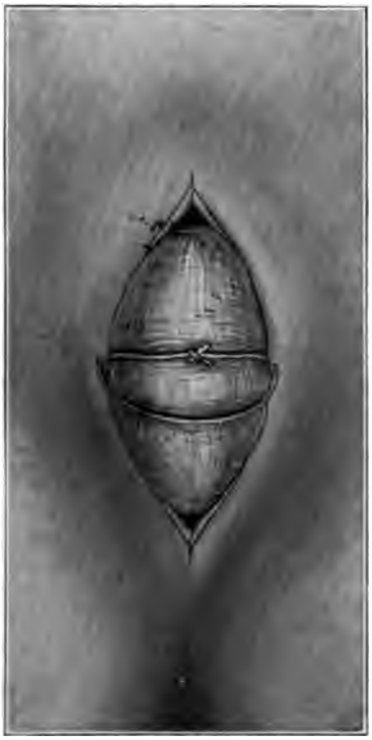

Fig. 81.—The gauze packing held in place by tied suture ends.

Three pregnant statements regarding *fixation* were made recently by von Eiselsberg,[19] in connection with the treatment of emergency wounds. They relate to:

(a) Fixation of bacteria surrounding the wound, and the protective bandages.

(b) Fixation of broken limbs through plaster casts, and

(c) Fixation of the patient on his bed.

We must emphasize the advantages of *elevation* and *suspension* as applied to the extremities. They favor circulation, and hence minimize edema, relieve pain, and altogether hasten repair.

It will be found advisable to *splint* an extremity on which there is an infected wound. The patient should remain as quiet as possible, since motion favors spreading of infection through the lymphatics, causes pain and delays healing. The dressing can be changed through a fenestrum (Fig. 83) in the cast. The splint is especially advantageous when combined with elevation or suspension.

The constant exposure of granulations to a *blast of dry air*, preferably warm, is said by Bergeat[20] to hasten drying up, and the whole healing process; it should be applied for five or ten minutes at a time. In this connection a hot air chamber is highly recommended for decreasing edema, and promoting shrinking of the swollen region; it will also be conducive to the comfort of the patient and assist repair through improving the circulatory conditions.

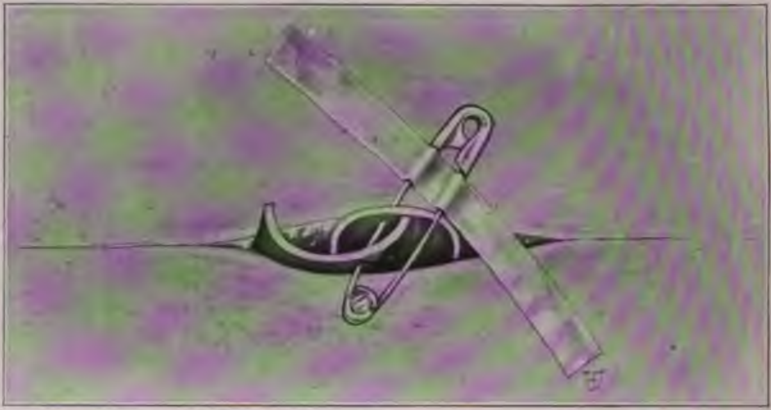

Fig. 82.—Split rubber tube drain as used at the Mayo Clinic.

Close attention must be paid that *granulations are not torn*, or caused to bleed by changing of gauze, and especial care should be given that this does not occur at the edge of the skin. It is wise to use a protection of gutta percha (Fig. 79); this renders the dressing painless and is favorable to rapid epidermization.

Time is saved in the healing of large defects, after the wound is cleaned up and granulations are healthy, by *drawing the skin edges to-*

gether, and adhesive plaster will be found most convenient in this connection. Strips are to be placed a short distance apart, to allow the escape of wound fluids.

Very often the patient complains of the *offensive odor* of the dressing. The sprinkling of two or three drops of formalin upon the bandage is a suggestion which, if carried out, will be found most efficient in overcoming this annoying detail. In wounds communicating with the mouth, a packing of gauze soaked in comp. tr. of benzoin, which may remain in several days, will completely dispose of the characteristic odor, and a little alcohol, sprinkled upon the bed clothes, not far from the patient's face, is an effective help in disguising disagreeable smells.

It is vastly more difficult to lay down rules concerning the *changing of dressings* on infected, than on clean wounds. Briefly, we may say that every instance is a law unto itself, and the amount and character of the excretions, the saturation of the dressings and its odor, the sensations of the patient, as well as the temperature chart, must govern the surgeon.

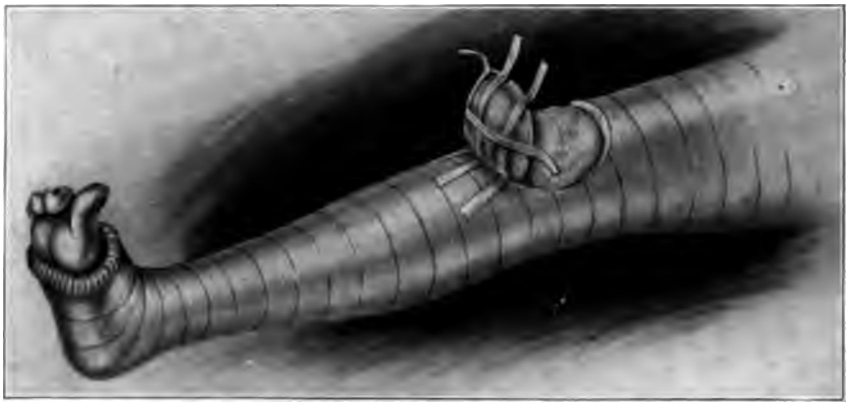

Fig. 83.—Fenestrum in a plaster cast as used at the Mayo Clinic.

Foreign Substances.—It is a well-known fact that the healing process in wounds is delayed by the presence of foreign substances, an example of which is seen when we strangulate a mass of tissues with a ligature. Among the many illustrations of this truth, which present themselves to mind, is a case in which a bone fragment in an infected wound causes a discharging sinus; the wound remains open, refusing to heal, until the removal of the fragment, after which it readily responds to treatment. In another instance, a particle of clothing, carried in by a projectile, had much the same effect. Very frequently small gauze pads have been left in wounds, causing infection and sinus formation, which necessitates removal. Infected nonabsorbable ligatures act similarly, and we may mention that drain tubes, which are not fastened, and through careless handling, slip in, frequently make operative removal necessary.

Some Remote Consequences of Wounds.—One of the most common consequences is a painful scar, as, for instance, after burns, when very frequently the nerve endings are caught. If the scar is near a joint, limitation of its movements, and consequent pain is present. Radical breast operations are a very usual cause for this distressing limitation at the shoulder joint. The best prophylaxis is early movement. Scars are very frequently most disadvantageous about the hands and fingers, in that the resulting limitation of motion impairs the usefulness of the member, which in many cases, decreases the earning capacity of the patient. It sometimes occurs

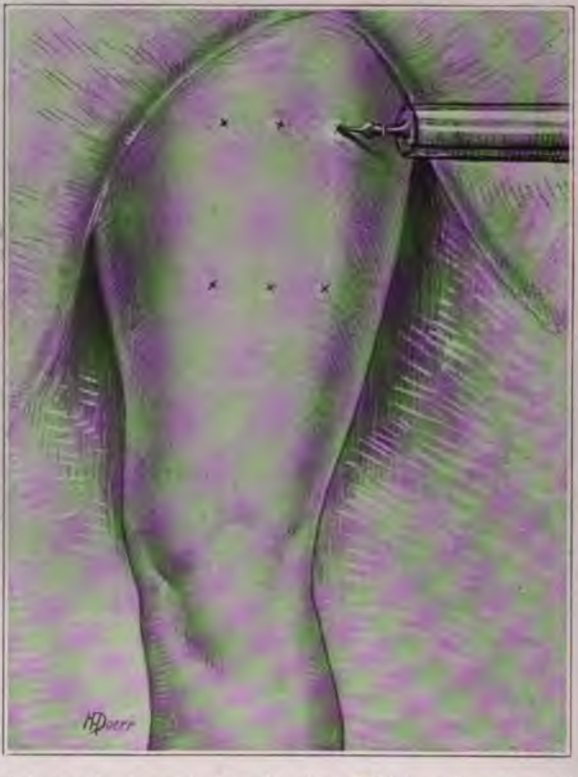

Fig. 84.—Injecting local anesthetic under skin of thigh previous to cutting grafts.

that a large nerve is caught in a scar. This is most common after fracture. Very recently I released the ulnar nerve, just above the elbow, and made a fat sheath for it.

Cancer sometimes forms in a scar; it is usually in an old one, and is most frequently met with in elderly people. Quite lately I amputated the foot of an elderly gentleman, for cancer under the heel, which appeared in the scar of a burn, received thirteen years previously. At the present writing, I have under treatment, an old lady with an extensive cancer in the scar of a varicose ulcer, just above the inner aspect of the ankle joint.

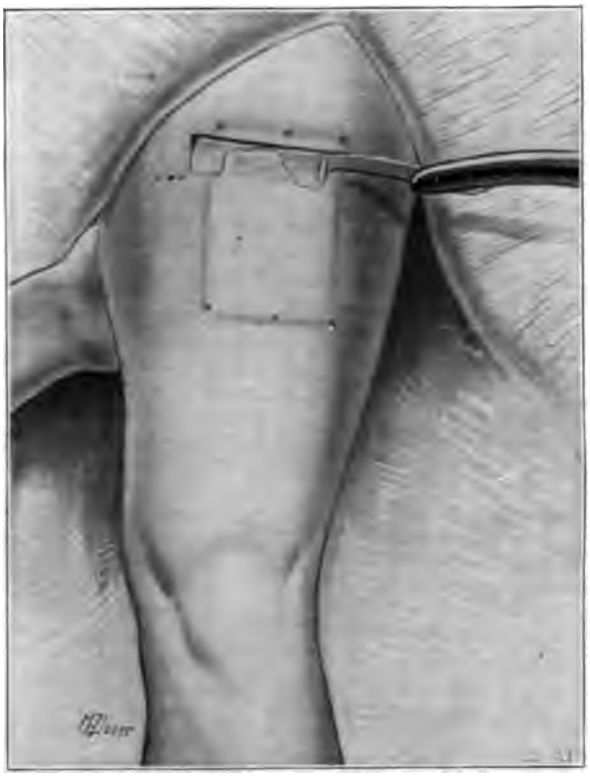

Fig. 85.—Cutting the grafts with a razor.

Late Treatment of Wounds.—In the late treatment of wounds, I have found skin grafting (Figs. 84-93) to be of the greatest value in hastening the repair of extensive granulating surfaces, and am in favor of covering the defect completely. Sprengre[21] advises dividing the wound by two or more skin-flaps, transversely across—one from each side, and meeting in the center, if necessary.

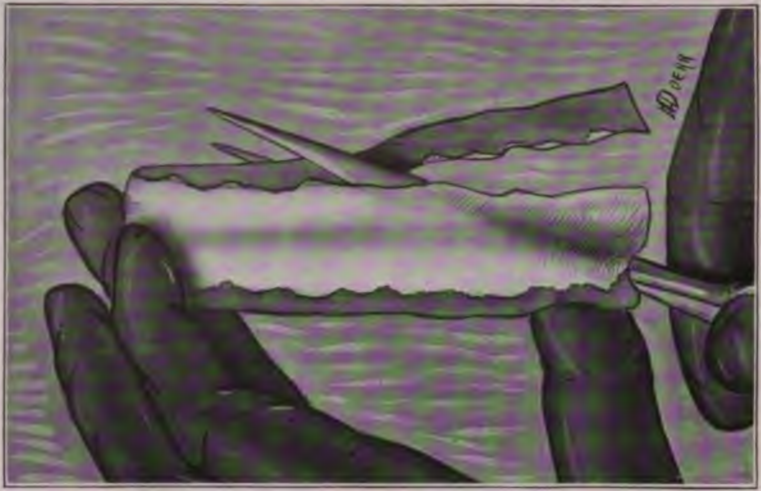

Fig. 87.—Trimming irregular edges of graft and gutta percha.

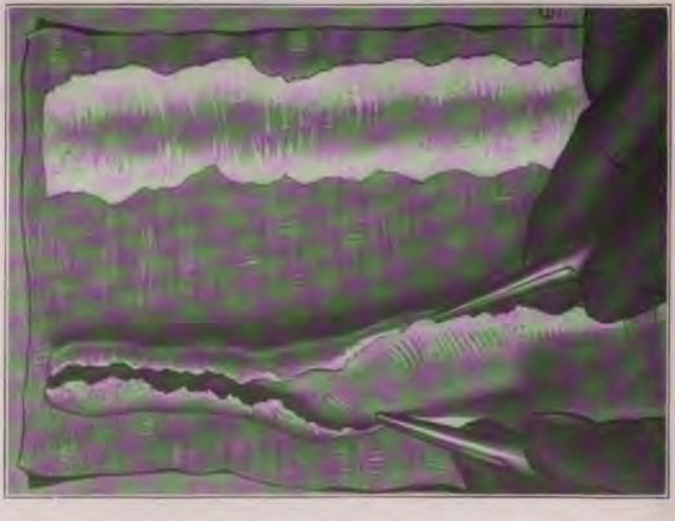

Fig. 86.—Spreading the grafts on gutta percha.

This makes at least two new wound edges, in addition to those already existing, from which skin formation is hastened in a truly surprising way (Fig. 94). It is advisable to wait until all sloughs are cleaned off, and granulations are healthy.

Ugly disfiguring scars should be excised and the defect resutured, although I am of the opinion that keloid is best treated by radium or x-ray.

Depressed scars are greatly improved in appearance by a horizontal subcutaneous division, and the insertion of fat transplants. I have in several instances rebuilt a complete breast in this manner, after the removal of all but the skin, for benign tumor.

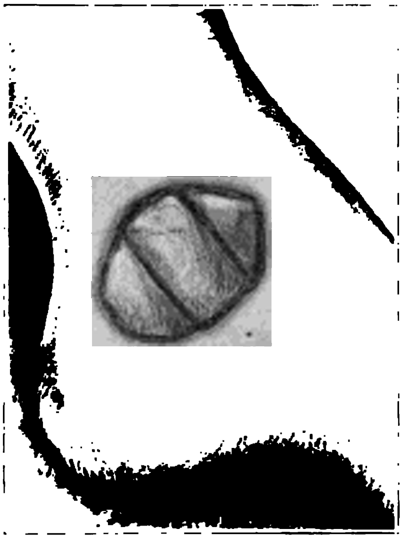

Fig. 88.—Grafts in place on a varicose ulcer of the ankle.

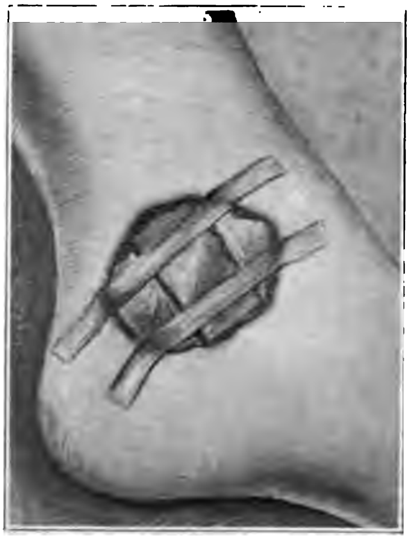

Fig. 89.—Cross layers of gutta percha, which fix grafts and their backing in place.

Transplantation of cartilage successfully corrects a depressed scar over ridge-like eminences. I have under treatment, as this is written, a boy with a depressed incisional scar across the bridge of his nose, which will be treated by subcutaneous elevation, and insertion of a thin section from a costal cartilage.

The transplantation of bone (Fig. 95) is almost too common at the present day, to merit more than a passing mention, nevertheless, it is possibly not so often done for cosmetic purposes, as is perhaps indicated. We formerly waited to get a clean field, but Law[22] has apparently secured as effective results in infected areas as well. Autotransplantation of bone, following the removal for carcinoma

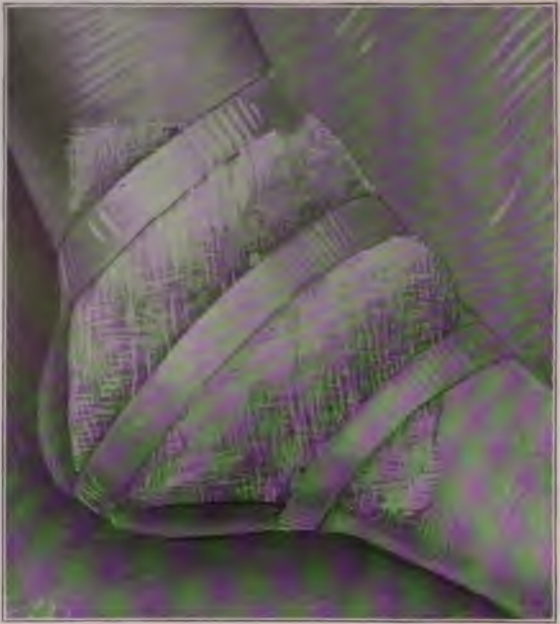

Fig. 90.—Gauze and adhesive which covers grafts and gutta percha.

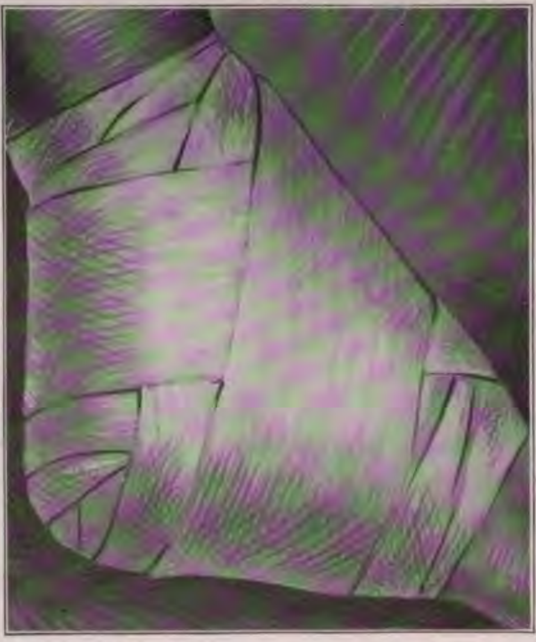

Fig. 91.—Ordinary gauze bandage which covers gauze and adhesive left on forty-eight hours.

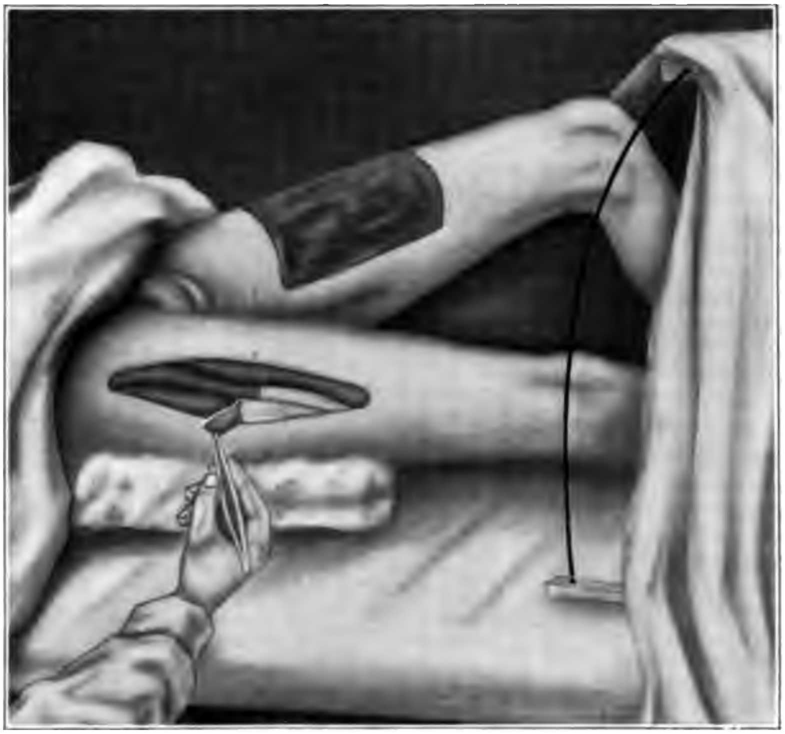

Fig. 92. Removing gutta percha after grafts have remained in place forty-eight hours.

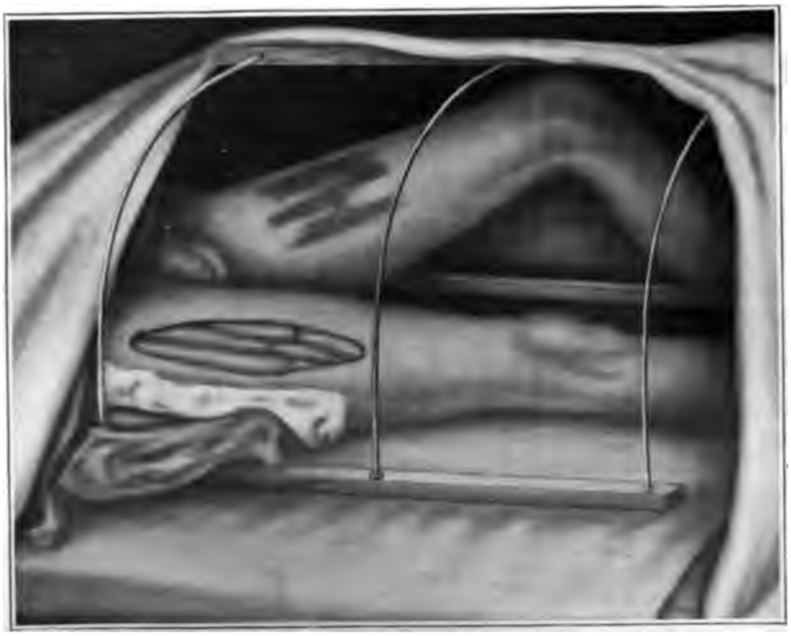

Fig. 93.—Open air treatment of grafts after first forty-eight hours' compression.

of that part of the mandible which forms the chin base, was recently accomplished by McKittrick. The region in which the graft was placed was infected and necessarily remained this way throughout the time the wound was healing. The ultimate outcome resulted in perfect restoration of the parts.

It is hardly necessary to mention that all grafts, no matter what tissue is involved, must be taken from the body of the same individual, since autografts alone can be depended upon to remain viable.

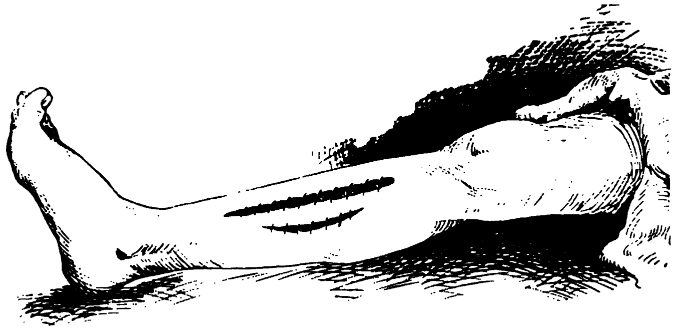

Fig. 94.—An attempt to cover an old granulating wound with a bridge of skin.

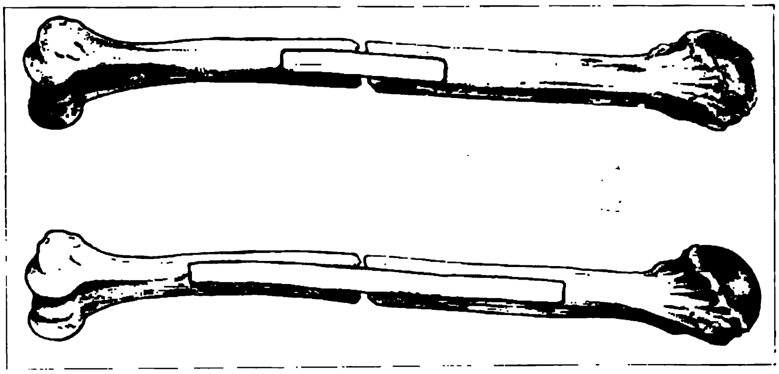

Fig. 95.—Autotransplantation of bone.

It is unfortunate that this important subject must be treated in a fragmentary way. A large monograph would be required if every detail of it were to be exhaustively considered.

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CHAPTER XLIX

BANDAGING

By O. F. McKittrick, St. Louis, Mo.

Bandages play an important role in the care of the postoperative patient. Their use is not so extensive in this day of open wound treatment as formerly, but they are still found indispensable in holding various regional wound dressings, supporting splints, immobilizing points, applying pressure for arrest of hemorrhage, Bier's hyperemia, compression of varicosities, and many other conditions which arise in the daily routine nursing of the surgical patient.

The most common materials utilized for this purpose are usually bleached or unbleached muslin, crinolin, or this latter dress lining to which some hardening substance has been added as plaster of Paris. The elastic bandage also has a wide range of usefulness. Ordinary hand towels are employed with great effectiveness by some surgeons. These came into use through Mayo's description of the handkerchief bandage, and was first introduced in our work by Vilray P. Blair.

Bandages are classified as simple or compound. In the former the material is in one piece, as exemplified by the ordinary roller bandage. In the latter two or more pieces of material are used, these being cut to suit the individual portion of the body to be covered. The crinolin or plaster of Paris bandages are usually referred to as *immobilizing* bandages, while the rubber bandage is considered a *pressure* bandage. In order to adequately describe the method of applying the bandage, the free end is called the *initial* extremity and the closed end is known as the *terminal* extremity, the portion between these points is designated as the body. The surfaces may be conveniently designated as *inner* and *outer*, respectively.

In describing the towel bandage, the first fold made preliminary to applying it is called the *initial fold*, while the sides, ends, and corners of the towel retain their original names.

Roller muslin bandages are most conveniently supplied in rolls of five to ten yards long and are the full width of the muslin. This is usually 36 to 42 inches. The width of the bandage itself

(1 to 6 inches) is regulated by cutting them off the main roll as shown in Fig. 96. In case it becomes necessary to roll a bandage, machines especially manufactured for this purpose may be employed, either the whole width of the muslin is encased in the roll or the width of the bandage alone. In most instances, however, these conveniences are not within reach, and the bandage is rolled by hand. In order to do this several folds are made into a small uniform roll. This is now grasped by the thumb and middle finger of the right hand and revolved in the left hand so as to force each revolution to add material to the roll from the strip of muslin which is drawn through the forefinger and middle finger of the left hand as shown in Fig. 97. The roll can then be wound as tightly as desired through the tension exerted by the fingers of the left hand.

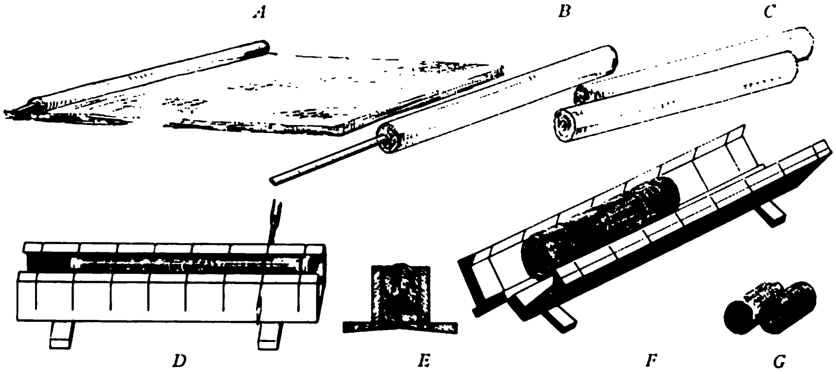


Fig. 96.—Method of cutting a roll of muslin into bandages, devised by Pattingson of the Mayo Clinic.

A. Muslin, 36 inches wide, 10 yards long, being tightly rolled over a yard stick which is pulled out at the end of the roll in order to show.
B. Finished roll, yard stick partly withdrawn.
C. Finished rolls ready to cut into bandages.
D. Cutting the bandages into desired widths in a miter box. This box is made of pine. The top and ends are left open, and the sides are sawed so as to permit the use of the Christy knife. The bottom is divided into equal parts which are fastened with hinges. Four foot pieces support the whole. These are so arranged that the bottom of the box is beveled. This, together with the three-cornered pieces of wood placed on each side at the top and bottom inside the box, holds the bandages absolutely tight as pressure is placed on them during the cutting. The instrument for this purpose is an ordinary Christy (bread) knife.
E. End of box showing the bandage held securely by the four three-cornered pine strips within the box. Note the beveled bottom of the box. This permits pressure as desired during the cutting process.
F. Bandage box open with cut bandages ready for removal.
G. The finished bandages.

Before a bandage is applied, the parts to be covered are thoroughly cleansed with water, alcohol, and then dusted with talcum powder. If a wound is to be covered, it is covered first with gauze and cotton batting or sheet wadding. It is also to be observed that bony prominences are to be treated likewise, and occasionally it is desirable to have all the parts protected with this material. No two skin surfaces are to be allowed to come in contact, cotton or sheet wadding being intervened.

In applying the roller bandage, the body is contained in the right hand, the initial extremity held in place by the left, and the bandage rolled away from the operator. In this way the inner surface becomes the center. Wrinkles in the cloth are to be avoided. The edges of the exposed strips of bandage are turned in while they are being applied, and a firm smooth application of the bandage, which is not too tight, is the object to be attained. The extremities are wrapped from the distal end towards the body of the patient, always bearing in mind the danger of ischemia with gangrene from too great or uneven pressure. The terminal extremity is nicely folded to a point and fastened with adhesive or a safety pin.

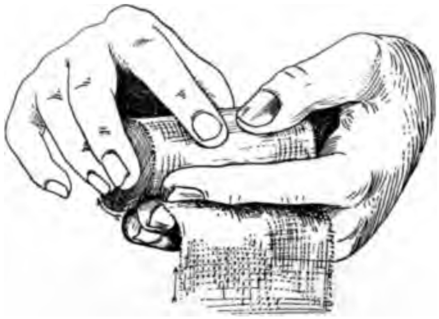


Fig. 97.—Rolling a bandage by hand.

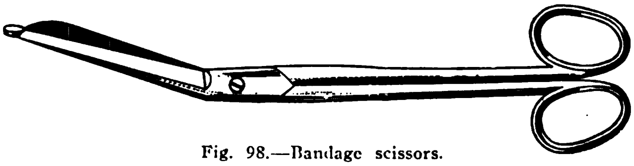


Fig. 98.—Bandage scissors.

In removing the bandage it may be cut with bandage scissors (Fig. 98) or unwrapped. The folds are kept massed together, which facilitates the transfer of the unwrapped bandage from one hand to the other.

A concrete description of the various kinds of bandages employed is not indicated in a work of this kind, but rather in one in minor surgery. Still there are a few points which should be discussed and to these, only, will attention be directed.

Head Bandages.—In placing the frontooccipital bandage the initial extremity of a roller two inches wide is held beneath the occipital protuberance and the body is then carried around the right side of the head across the forehead and then around the left side of the head to the starting point. The turns are repeated, each time a part of the preceding turn being left uncovered. The exposed edges are turned in as shown in Fig. 99 and the terminal extremity fastened at the side with adhesive.

In covering either of the parietal regions alone the bandage is fixed as in the bandage above, one or two turns being made so as to more firmly secure it; then beginning at the occipital protuberance the body is passed obliquely over the parietal eminence to the forehead, where it is held with the finger directly above the eyebrow. From here it is doubled back and continued to the occipital protuberance below the first strip of bandage, part of its external surface being left exposed. The bandage is now brought back to the region of the eyebrow; this time, however, the body passes above the first layer. The body is continued back and forth in the manner described until the region is covered. Then the bandage is secured by another turn or two around the head as in the beginning. All edges are turned under as the folds are placed. The terminal extremity is fastened at the side with a strip of adhesive.

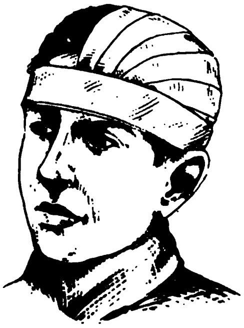


Fig. 99.—A head roller bandage.

A recurrent bandage is commonly employed to cover the entire vertex. The initial extremity of a roller two inches wide and six yards long is fastened by the frontooccipital turns as described above, then beginning at the forehead the bandage is doubled on itself and brought directly over the head to just under the occipital protuberance, making a right angle with the first turns.

From here it returns to the forehead only to be taken back to the point beneath the protuberance. This is continued, each turn covering the lower portion of that gone before, until the vertex is completely lost to view. The ends of the folds are then secured by several frontooccipital folds and the terminal extremity having been nicely brought to a point, is held in place with adhesive.

In the hands of some, as mentioned above, it is much easier to use an ordinary towel in bandaging this region of the body. A

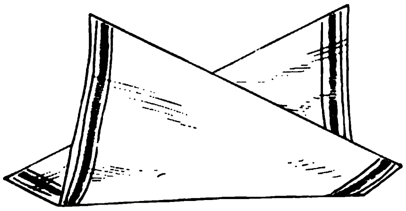


Fig. 100.—A towel folded for bandaging.

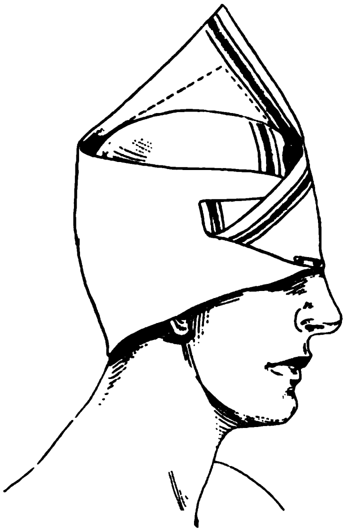


Fig. 101.—First step of applying towel bandage to head.

towel, preferably 16 x 24 inches, and one that has been washed frequently and is therefore soft and easily handled, is folded as in Fig. 100. For the adult head, unless, of course, too much dressing has been already placed, this size towel, folded, will be found most satisfactory. After folding the towel, the center of the largest surface shown in the figure is placed directly on the back of the head, the region of the initial fold passing under the occipital protuberance. The ends are then brought across the sides of the head above the ears, and fastened at the root of the nose as in Fig. 101. Here it can be made as tight as desired by simply pulling the two extremes of the initial fold and then pinning them in place.

The corners of the towel now protrude as seen in Fig. 101, one having been simply tucked under the other. The opposite corner is at once brought over firmly and smoothly and fastened as in Fig. 102.

If it is unnecessary to include the eye (or eyes), the initial fold of the towel is simply brought further down on the side of the head, above the ears and fastened over the bridge of the nose. In this case the completing folds will be shorter than the preceding bandage and will terminate as in Fig. 103, the same tucking process having been carried out as in Fig. 102.

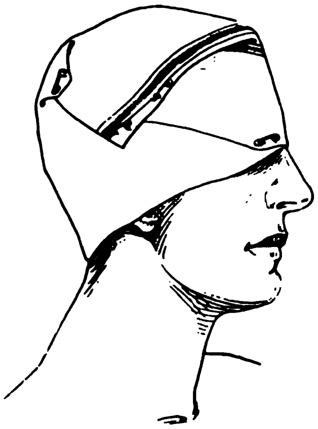


Fig. 102.—The completed head bandage, eyes and ears (if desired) included.

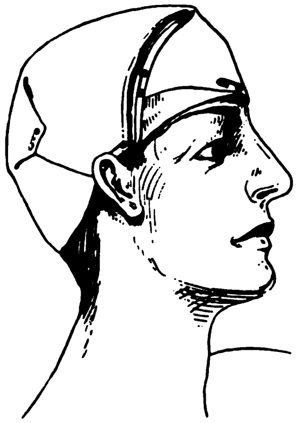


Fig. 103.—The completed head bandage, eye (or eyes) excluded.

In bandaging a stump the recurrent roller bandage (Fig. 104) may be applied. It is placed, in the main, as a recurrent bandage of the head, and need not be further described. A towel is easily utilized here. One about the same as that in Fig. 100 is folded as there depicted and the initial fold is fastened around the extremity just above the stump. The corners are then tucked in and pinned as in Fig. 101. It is further secured by adding strips of adhesive plaster. The size of the towel depends on the size of the stump and the amount of dressings.

If such bandages are applied properly, they will stay on indefinitely, and will not become roughened and disarranged so quickly as the roller bandage. In unruly patients or the delirious, it may become necessary to attach muslin straps behind the ears and on the lower edge of the towel so that they can be tied under the chin in order to insure against the slipping of the bandage.

When one eye alone is to be included in the head bandage the bandage is folded as in Fig. 105, and applied as in Fig. 101, except that the side of the head and the adjacent eye are covered by the initial fold of the towel. The corners are tucked in as was done in Fig. 102. The final appearance of the bandage is shown in this figure.

More extensive covering of the head, i. e., one which includes the cheek as well as the eye, usually requires a larger towel. A size 16 x 28 inches is very desirable. It is folded as in Fig. 105. One corner is twisted preparatory to placing under the chin, as in Fig. 106. The initial fold of the towel is now adjusted around the neck and then pinned to the twisted corner. This gives the left side, the one requiring the bandage in the first place, more towel than the right, as depicted in the figure. The latter is first brought over the right side of the head and cranium, and being tucked in firmly, is at once covered by the former so as to make a smooth, even covering, the bandage being finished as in Fig. 107. The extent of the face covered on the right side is regulated by folding the towel to the desired extent. In bandaging the left side of the face and head, the towel shown in Fig. 105 is folded so as to present a right twisted corner instead of the left, and the folds made accordingly. The posterior aspect of the bandage shown in Fig. 108 appears in Fig. 109.

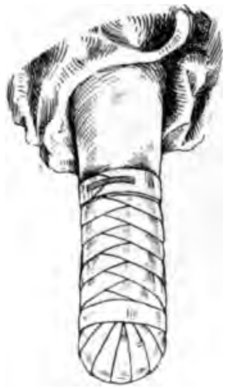


Fig. 104.—A roller bandage applied to an amputation stump (arm).

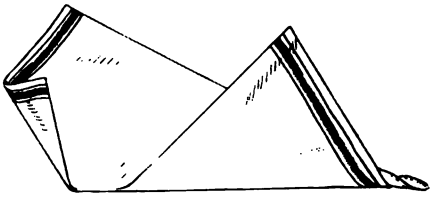


Fig. 105.—Method of folding towel for bandaging face.

Other bandages of the head including portions beside the cranium and excluding the towel coverings, are explained in text books on Minor Surgery. One of these which proves at times a valuable dressing is the Barton bandage or some modification of it. In placing this bandage the initial extremity of a bandage, two inches wide and six yards long, is held at the center of the vertex, and the body carried over the left parietal bone, under the occipital protuberance and then over the right parietal bone to the point of starting. From here it passes over the left temporal bone in front of the ear, along the side of the face to the chin, under this, then up the right side of the face and head to the starting point again. The body of the bandage is now carried over the left parietal bone again to the point under the occipital protuberance where it is extended around the right base of the skull along the right inferior maxilla and then around the left base of the skull to just below the occipital protuberance where it then follows the former strip of bandage to the center of the vertex. The process is repeated several times until the desired number of turns are made. This bandage is frequently modified by adding a frontooccipital turn before any of the turns are repeated. When this has been accomplished the turns are followed out in the order named above until the bandage is completed, the intersections being secured by means of adhesive or safety pins, care having been taken that all edges were turned under during the application.

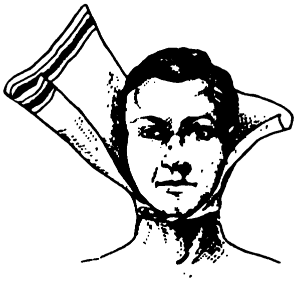


Fig. 106.—First step of face bandage.

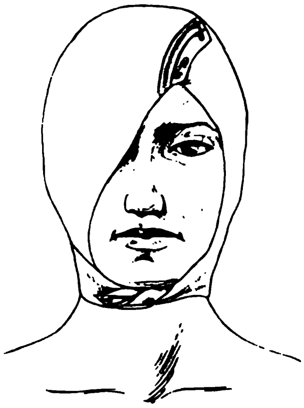


Fig. 107.—Final step for bandage of face and eye.

For the many other bandages of the head the reader is referred to text books on Minor Surgery.

Neck Bandages.—One of the simplest bandages of the neck is that shown in Fig. 110. It consists simply in a strip of gauze covering the dressing over the wound and fastened in place by two strips of adhesive. This is a particularly useful dressing for goiter patients, since it does not necessarily encase the whole neck. It was first brought to my attention at the Mayo Clinic.

Another simple dressing of the neck is that shown in Fig. 111. A roll of gauze 15 x 15 mesh to the inch is placed over the lesion on the neck, which in this case, is high up, reaching nearly to the lobe of the ear. In order to force the dressing to cover the lesion without resorting to a head bandage, a piece of cardboard or several layers of paper are cut as in the figure and incorporated in the dressing. The idea was originated and carried out by Frelich at the Mayo Clinic.

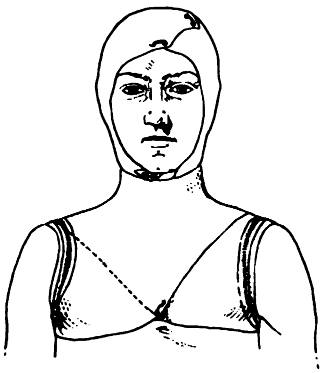


Fig. 108.—Final step in hood bandage for sides of face and head.

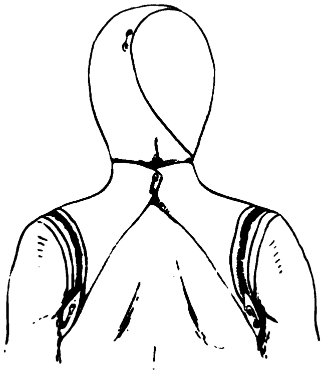


Fig. 109.—Posterior appearance of hood bandage.

An ordinary unfolded towel may be utilized as a neck bandage. It is placed around the neck and over the wound dressings without any preliminary folding and pinned as in Fig. 112. The small towel as shown in Fig. 100 fulfills this requirement very well.

This neck covering can also be used as the upper part of a breast bandage. A towel long enough to reach around the patient is folded at the sides and then passed around the chest and pinned as in Fig. 114. The posterior aspect of the combined bandage is shown in Fig. 113.

Probably a more secure bandage and one meeting the same demands is that shown in Fig. 108. A towel just large enough to fit the patient comfortably is folded in its longest dimensions (Fig. 115). The initial fold is placed directly around the neck and held in position with a safety pin. The ends of the towel as shown by the borders in Fig. 108 are then brought around the shoulder under the arm pits and pinned at the back. In order to force the bandage to remain snugly fit in front and also keep the sides of the towel in place, one or more safety pins are placed as shown.

This chest bandage is used in connection with the head bandage as shown in the illustrations, but it is a useful bandage applied without any complicating head dressings, and, as a matter of fact, is far more frequently employed separately.

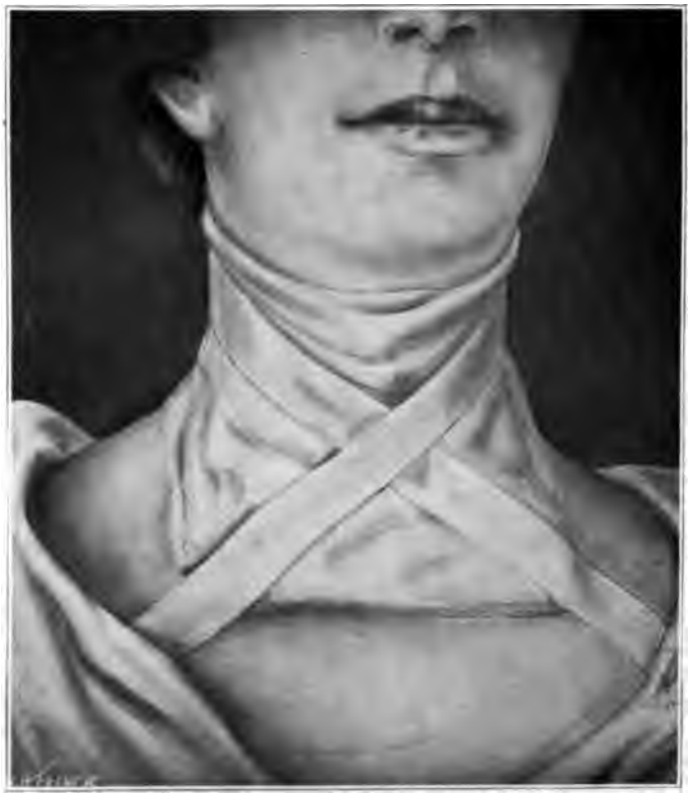


Fig. 110.—A simple dressing with gauze support for goiters.

In bandaging the **chest** alone, a simple towel folded as in Fig. 115 is taken by its farthest corners and brought around the body, the initial fold of the towel reaching the lowest point on the chest, while the ends encircle the arms as in Fig. 116, and are pinned at the back as shown in Fig. 117. The pin in front (Fig. 116) merely holds the two sides of the towel in close approximation. Such a bandage gives freedom to the arms, is easily applied and is comfortable.

Bandaging the **shoulder** and **axilla** is carried out by taking the towel (Fig. 115) by its extreme corners and placing it on the shoulder to be covered, the initial fold being brought nearest the base of the neck. It is now passed around the body to the opposite axilla and pinned at a point just past that region of the body. The initial fold being placed highest on the body, the sides pass around the patient at the lowest extent of the bandage, the ends of the towel being fixed around the arm and pinned at the axilla to be bandaged (Figs. 118 and 119). (In this case it is the right.) A gauze fold may be placed over the opposite shoulder to hold the bandage more securely.

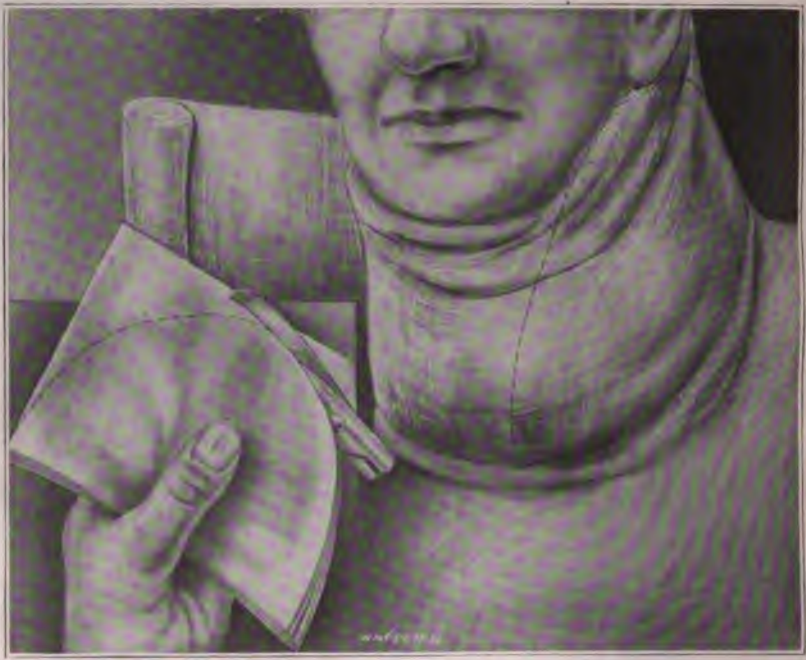
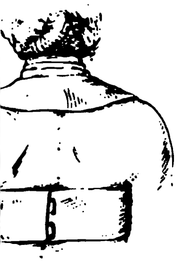


Fig. 111.—A high neck bandage held up by cardboard inserts.

Fig. 120 shows a bandage being forced to fit by drawing the initial fold taut and pinning it on top of the shoulder.

Bandages more extensive than those in Figs. 108 and 109 are required following radical breast operations. Usually the first bandage applied is one which includes the arm for the first night. A small towel, unfolded, is laid over the shoulder so that its ends extend beneath a larger towel which covers the whole of the arm (Fig. 120). The breast wound protected with gauze and a sufficient amount of cotton being placed under the arm, this extremity is brought over onto the chest and the end of the towel pinned to its fellow of the opposite side. The front of the bandage is made straight at the points of contact by tucking in the lowest part of the end of the towel (Fig. 120). Safety pins are put at desirable points, one supporting the hand in its present position. Fig. 121 shows the posterior aspect of this bandage. The pins are holding in position the towel which was placed over the uppermost part of the shoulder.

Fig. 113.



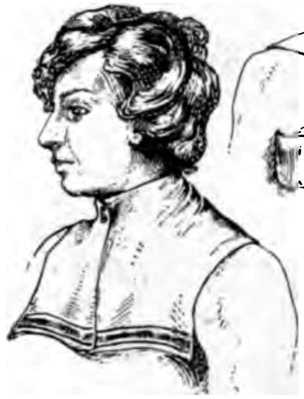


Fig. 112.

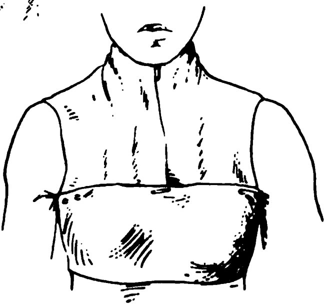


Fig. 114.

Fig. 112.—A simple neck towel bandage.
Fig. 113.—Neck and breast bandage as viewed from behind.
Fig. 114.—A combination neck and breast towel bandage.

A bandage which only partially limits the arm is used by some at this early stage. In these cases the shoulder bandage as shown in Fig. 118 is put on at the close of the operation and the circular towel brought around the arm as in Fig. 120, but not to the extent of including the forearm. The two surfaces are pinned on the inner aspect of the arm as they meet here, after encircling it, and the end now passing on meets its fellow of the opposite side and the two are pinned in the long axis of the body. The arm is partially restricted further by placing a wide strip of gauze around the wrist and pinning this to the towel around the chest.

The following day, when all bleeding has stopped, and it is desired to release the arm from the bandage, which was put on the patient while still on the operating table, this is removed without disturbing the dressings and a shoulder bandage as depicted in Fig. 118 is placed on the patient, the towel being forced to fit, if necessary, by pinning it just above the shoulder. A large unfolded towel is now brought directly around the body close up under the axilla (Fig. 122) and pinned in front parallel with the long axis of the body, even if it is necessary to tuck in the lower part of the end of the towel to accomplish this end. The shoulder towel bandage, and the circular towel bandage are further fastened by means of safety pins as shown in Fig. 123. Further restraint being unnecessary the gauze cuff (Fig. 124) is left off the wrist.

A double-breasted bandage is made by simply adding another towel to the left shoulder as in Fig. 125, or else placing a left shoulder bandage as in Fig. 118.

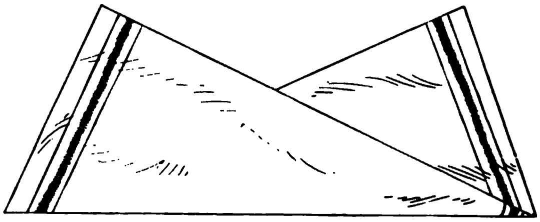


Fig. 115.—The towel folded as used in chest bandages.

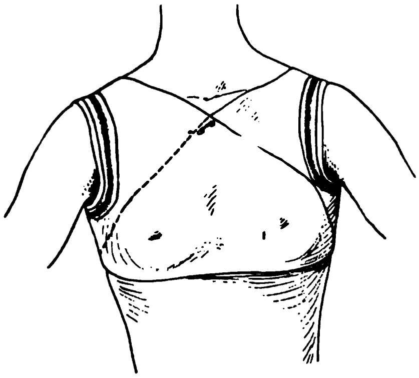


Fig. 116.—A towel chest bandage.

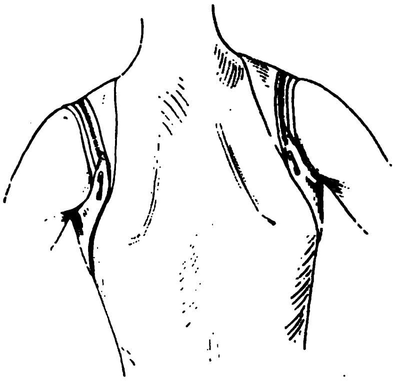


Fig. 117.—Posterior view of chest bandage.

If it is necessary to have the arm secured, methods resorted to in Figs. 120 or 124 are easily carried out.

Instances requiring still more fixation, as after operations for fractured clavicle, etc., where the towel bandage would be applied by unskilled hands, it may be safer to use the well-known Velpeau.

The skin is first thoroughly cleansed and powdered with talcum, suitable padding placed in the axilla and the other portions of the body to be covered are protected with sheet wadding. The arm is acutely flexed (Fig. 126) and brought across the chest so that the palm surface of the hand of the affected side rests on the opposite shoulder close to the base of the neck. Two or more bandages 2½ inches wide will be required. The initial end of a roller is held over the body of the scapula of the sound side. The body of the bandage is now carried over the unsound shoulder at its outer part and down along the lateral surface of the arm (Fig. 127), under the elbow and then across the body to the axilla of the opposite

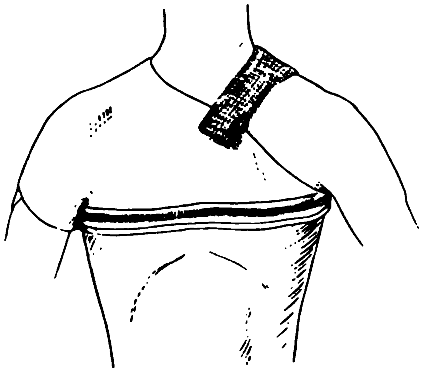


Fig. 118.—Towel chest shoulder bandage held in place by strip of gauze.

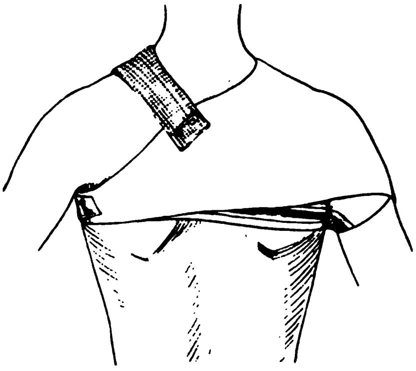


Fig. 119.—Chest shoulder bandage as shown from behind.

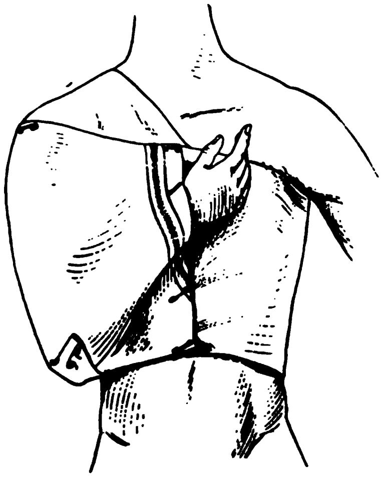


Fig. 120.—Chest towel bandage with arm included.

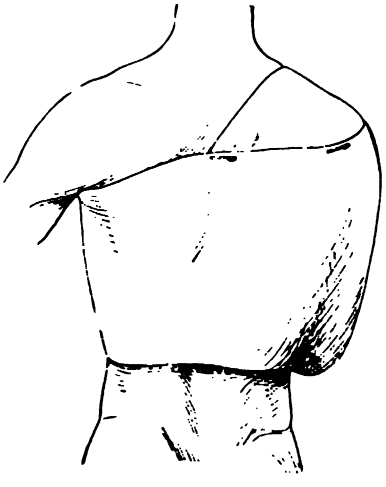


Fig. 121.—Fig. 120 as viewed from behind.

side to the beginning point. This turn is repeated once or twice in order to thoroughly anchor the bandage. Starting again at the scapular region, the bandage is brought directly around the body across the point of the elbow, across the axilla of the sound side and back again to the place of starting. The bandage is now carried over the unsound shoulder, covering the inner two-thirds of the

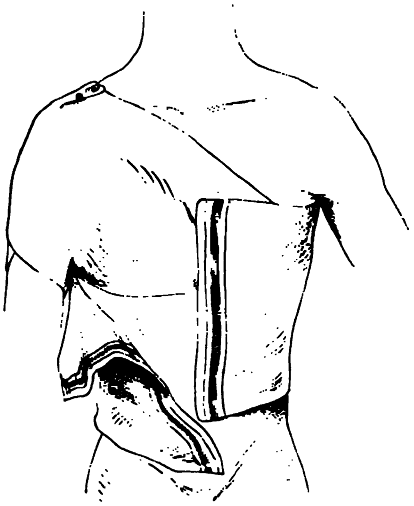


Fig. 122.—A double towel bandage for chest and shoulder.

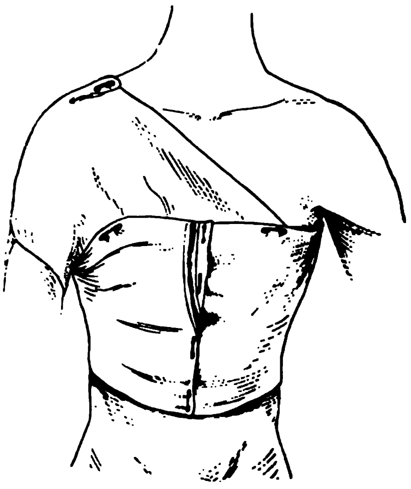


Fig. 123.—Second step of chest shoulder bandage.

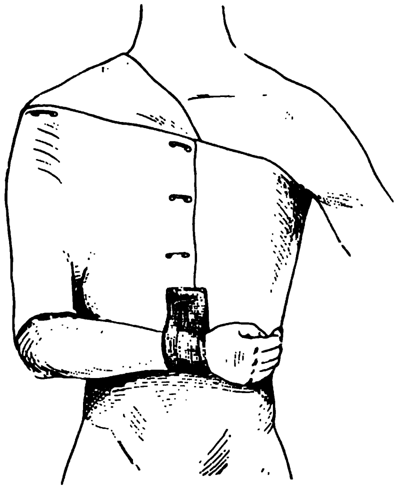


Fig. 124.—Arm held in position by accessory fold of bandage pinned to lower edge.

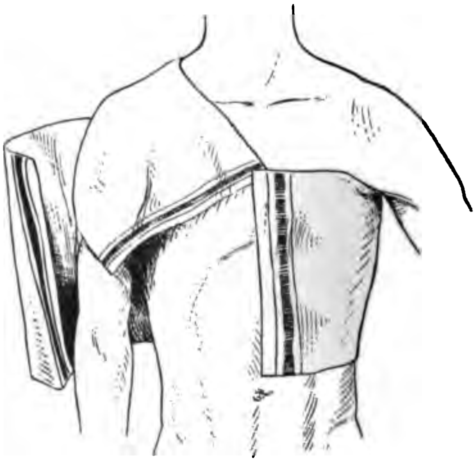


Fig. 125.—Beginning step in shoulder breast bandage.

strip which has gone before, passes behind the elbow and follows the course of the first strips, care being taken to cover the upper

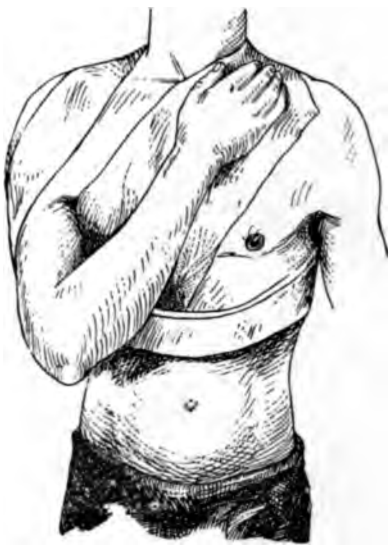


Fig. 126.—First stage of Velpeau.

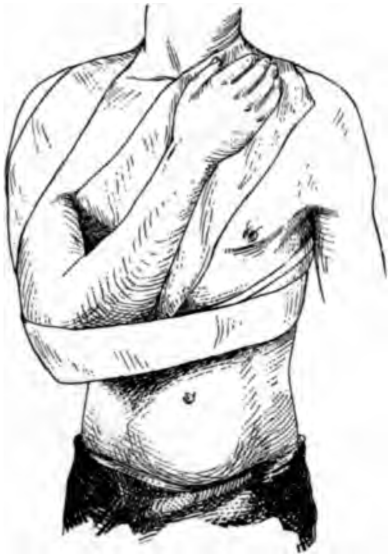


Fig. 127.—Second stage of Velpeau.

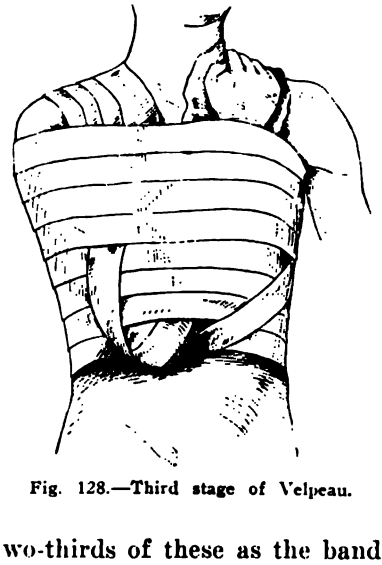


Fig. 128.—Third stage of Velpeau.

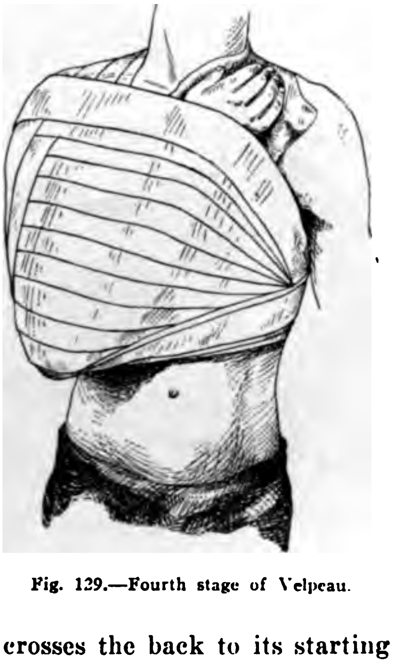


Fig. 129.—Fourth stage of Velpeau.

two-thirds of these as the bandage crosses the back to its starting point over the scapula. The process is now repeated until the arm is bound securely and all surfaces covered, the bandage traveling from without inwards across the shoulder, and upwards across the arm and chest (Figs. 128 and 129). The terminal extremity is fastened with adhesive where it ends. Other strips of adhesive are used at points which are in danger of slipping.

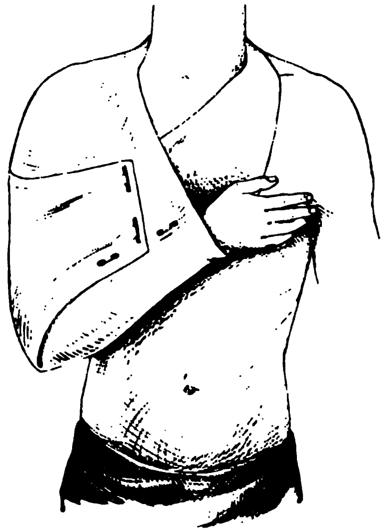


Fig. 130.—A convenient towel sling for arm.

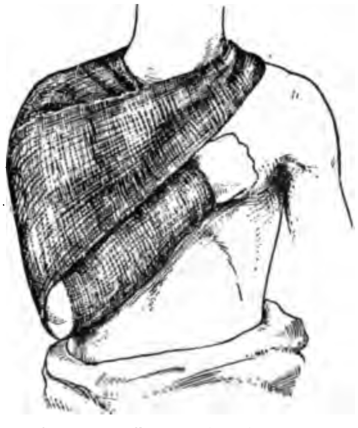


Fig. 131.—Gauze sling for arm.

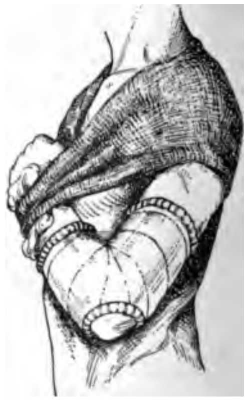


Fig. 132.—Gauze sling supporting wrist of arm encased in plaster of Paris dressing.

Bandages of the upper extremity may be composed of the regular roller or common towel. In utilizing the former the spica of the shoulder, the figure of eight at the elbow or the spiral reverse for the whole arm is usually employed.

Description of these is superfluous. The same, however, can be accomplished by the towel, this folded and applied as shown in Fig. 130, which depicts the method of bandaging the lower extremity is also used here. The extent of the surface to be covered regulates the size of the towel and the length of the initial fold. A larger surface requires a larger towel, and the length of the bandage determines the amount of towel turned under. Figs. 131 and 132 depict a good gauze bandage for the shoulder and arm (Mayo Clinic), while Fig. 133 shows how the neck can be protected from pressure.

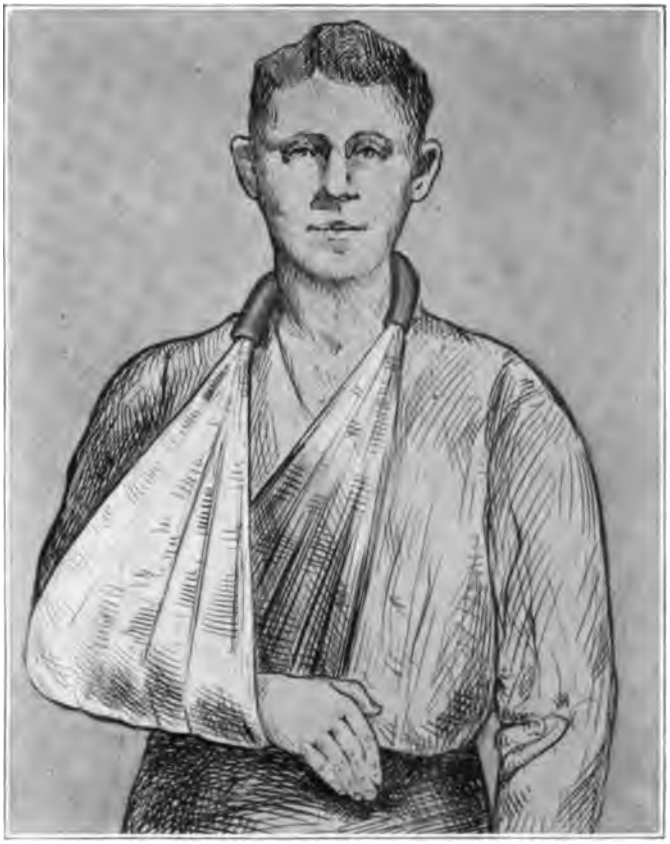


Fig. 133.—The sling run through a rubber tube to protect the neck from pressure. Forearm is drawn *too low* in the figure.

In placing a towel bandage of the **hand,** the towel should be about 16 x 20 inches and folded as in Fig. 134. The initial fold is brought around the wrist and secured with a safety pin. Then the side of the towel is brought under the thumb and the edges tucked nicely over the dorsal surface of the hand (Fig. 135) the towel then ready to complete the final folds is straightened out as in Fig. 135. This is now simply wound around the hand and pinned

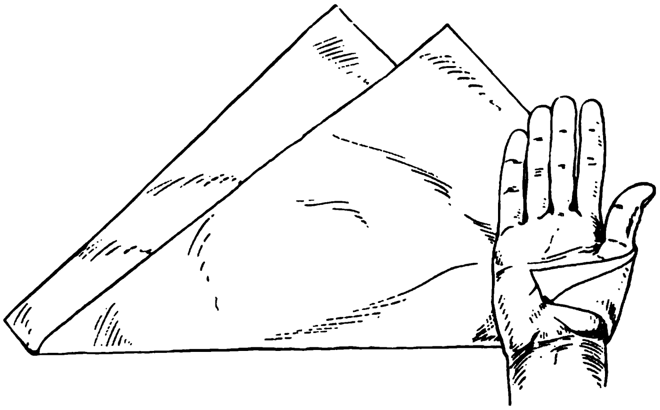


Fig. 134.—A towel folded for purpose of bandaging hand. First step.

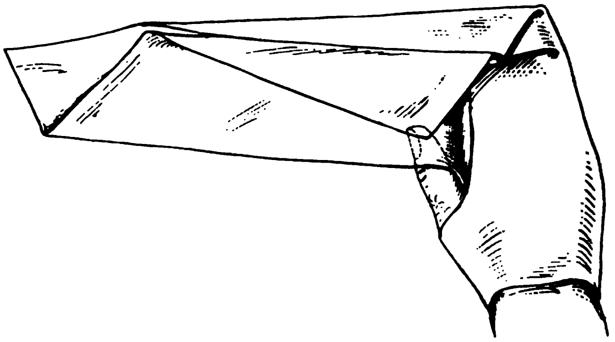


Fig. 135.—Second step in towel bandage of hand.

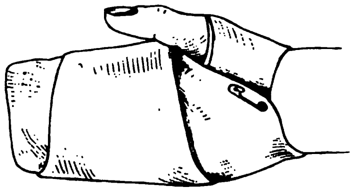


Fig. 136.—Final step of towel bandage of hand. Palmer aspect.

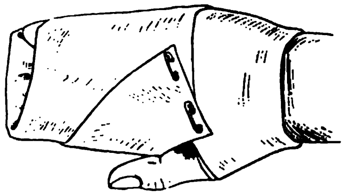


Fig. 137.—Final step of towel bandage of hand. Dorsal aspect.

as in Fig. 136, which shows the dorsal surface, while Fig. 137 shows the palmar surface. The whole procedure resolves itself into starting with the right sized towel with some of its parts folded on the bias. The rest is a matter of individual folding of the towel so as to make a neat appearance.

Bandaging the fingers is best done with the roller bandage, the description of which is found in books on this subject.

Abdominal bandaging is accomplished by the abdominal dressing and binders described elsewhere in this book.

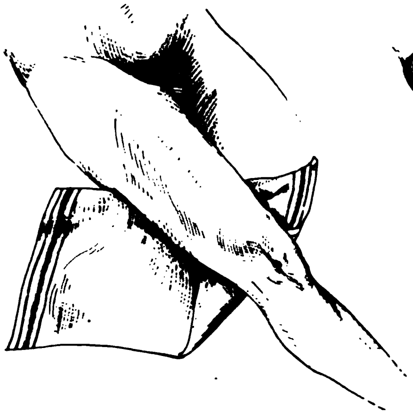


Fig. 138.—First step of towel bandage of thigh.

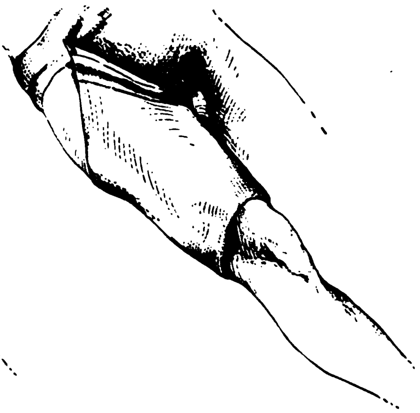


Fig. 139.—Second step of towel bandage of thigh.

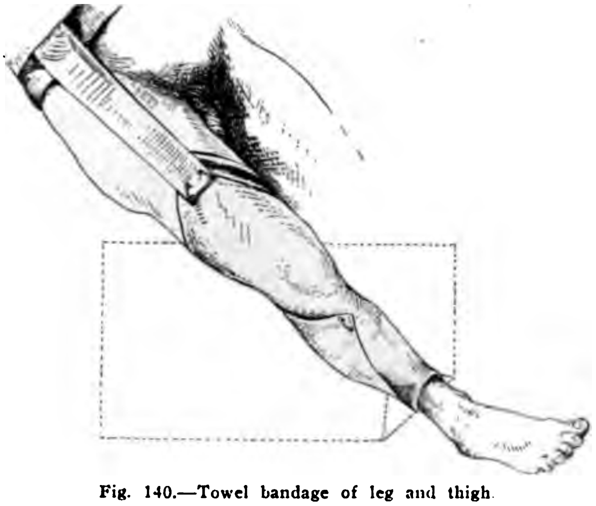


Fig. 140.—Towel bandage of leg and thigh.

Bandages of the **lower extremities** are usually composed of the roller as for the arm. Here too the spica of the groin, knee, ankle, and foot or the spiral reverse of the whole lower limb need not be described. Towels taking the place of these bandages are shown in the accompanying figures. Fig. 138 shows a towel folded preparatory to covering the thigh. The initial fold is first anchored around the thigh by means of a safety pin and then the rest of the towel is simply folded around, drawn firmly and finally completed as in Fig. 139. A roll of gauze or folded towel fixed around the waist supports the upper corner of the towel by means of a pin. For more extensive covering of the limb a larger towel is secured and the initial fold is made much shorter than in Fig. 138. In this instance it is first placed just above the ankle, the towel now is simply drawn around the limb and pinned as in Fig. 140. A band of gauze pinned to the waist band keeps it firm along the course of the extremity.

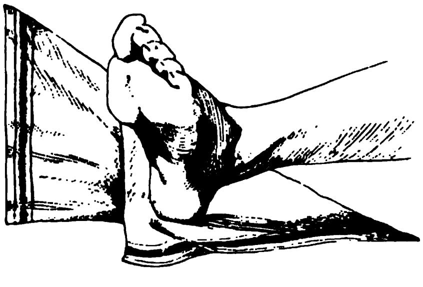


Fig. 141.—First step of towel bandage of foot and ankle.

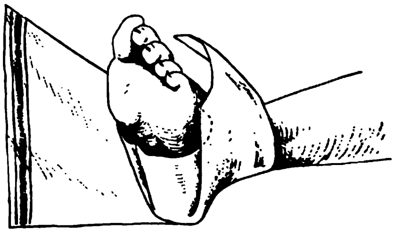


Fig. 142.—Second step of towel bandage of foot and ankle.

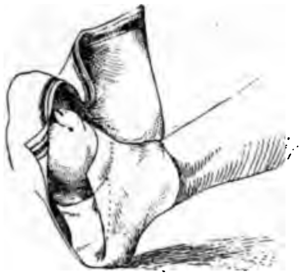


Fig. 143.—Third step of towel bandage of foot and ankle.

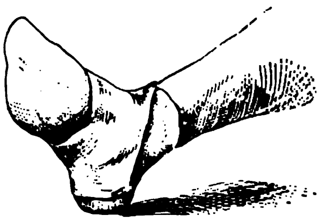


Fig. 144.—Final step of towel bandage of foot and ankle.

In bandaging the foot the towel which is best used is much smaller than the one employed on the limb above. It is folded as in Fig. 141, when the foot is placed onto it, the corner nearest the heel is brought up around the plantar surface of the foot. The end of the towel is now pulled tightly over the dorsal surface and tucked in on the inner side (Fig. 142) the other end of the towel is folded over the toes as in Fig. 143, the final appearance of the bandage being something like that in Fig. 144. Pins are placed at convenient points and any tucking of the towel necessary to make a firmer as well as a neater appearance to the dressing.

T-bandages are very useful. They are either single (Fig. 145,) or double (Fig. 146), and are used mostly for holding perineal dressings in place. The single T-bandage is composed of two strips of unbleached muslin hemmed and sewed together in the form of the letter "T." The top strip should be about 4 x 38 inches, the other strip 3 x 16 to 20 inches.

The double T-bandage is made the same way, the part employed to pass around the body has the same dimensions but the part which passes over the perineum is divided in the middle (Fig. 146). This piece is the same length as in the single "T" but is an inch or more wider.

A T-binder of the chest is a very handy contrivance at times. It is composed of a bandage about twelve inches in width and long enough to pass around an adult's body. The strip is fastened to its upper edge so as to pass over the shoulder. Another strip passing over the opposite shoulder is sometimes used. The strips are pinned in front, so also is the binder, all slack being taken out by mean of pins.

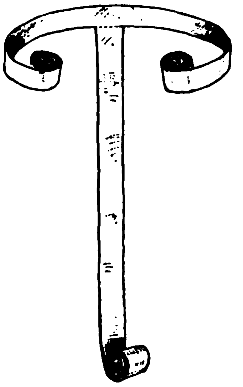


Fig. 145.—Single T-bandage.

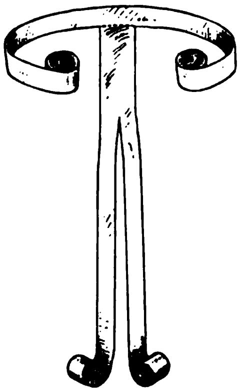


Fig. 146.—Double-tailed T-bandage.

Suspensory bandages are extremely necessary after operations involving the testes or any part of the anatomy near this region as well as the groin.

For the first few days ordinary adhesive plaster strapped to the sides of the thighs and passing directly under the testes may be used. Cotton is placed directly under the testes so as to avoid possible irritation and give a still better support. (Fig. 62.)

An ordinary piece of gauze brought around the testes and held with adhesive alone makes a quite efficient suspensory so long as the patient remains in bed.

Adhesive placed directly on the scrotum and then fastened to the abdominal wall is sometimes employed. The scrotum, unless shaved, will give more or less pain due to the hair which will be pulled by the adhesive. It holds the scrotum well up and prevents edema, but on account of the fault mentioned is not a comfortable suspensory.

By far the best apparatus for this purpose is one consisting of a web body which supports the testes and at the same time is itself held in place by a small waist band and perineal straps. This suspensory is best used late in the course of the recovery since a better fit can be obtained at this time as the edema will have disappeared from the scrotum and unnecessary irritation and pressure from the straps are avoided at a time when the tissues are most susceptible to injury. The surgeon should fit these suspensories, as one too tight will cause trauma and swelling, while one too large is of little value.

The most important immobilizing dressing is the **plaster of Paris bandage.** Fixation bandages have been in use many centuries, a mixture of other material, such as chalk, mussel shells, albumen, oil, hemp, etc., having been utilized in their manufacture. It was not until the middle of the nineteenth century however, that the plaster of Paris bandage, which now holds the foremost place in this kind of dressings, came into common use.

The bandage, as ordinarily employed, is bought ready made from the stores, and so often does not fulfill the expectations of the operator. This is due to many causes. In the first place, it may contain too much calcium carbonate, which prevents complete hardening of the plaster, when mixed with water. The plaster may have absorbed too much water, due to exposure to the atmosphere, or in drying out such plaster, it may have become too hot, and thereby rendered it almost useless, since it then takes up water poorly. The plaster may have been shaken from the meshes of the crinolin by too severe handling in shipping, etc.

The most satisfactory bandage is one made of crinolin (25 x 25 meshes to the inch) and the best grade of dental impression plaster, smoothly and uniformly filling the meshes throughout the bandage. Such bandages are conveniently made by buying crinolin by the bolt. Each bolt contains twelve yards, folded in half-yard lengths. The bolt is cut at the sixth fold, which exactly divides it, leaving therefore six yards to the piece. Each piece of crinolin is now rolled on a yard stick (Fig. 96, page 441), and put away for a week or more until the former creases have disappeared from it; at the end of this time the roll is placed into a miter box, and cut with a Christy knife, into widths the size of the required bandage. The miter box (Fig. 96), as employed by Pattingson, who prepares all the bandages used at the Mayo Clinic, is beveled at the bottom, so that pressure from the top forces absolute fixation of the crinolin, during the cutting, which naturally insures a more uniform roll. As employed at this clinic, the rolls are 4 and 6 inches, respectively, though any size roll may be cut.

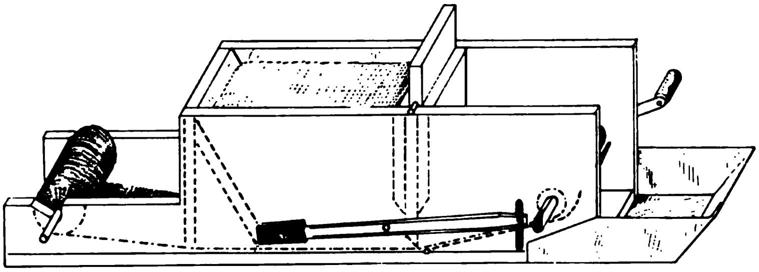


Fig. 147.—Pattingson's plaster bandage rolling machine used at Mayo Clinic. (Viewed from the side.)

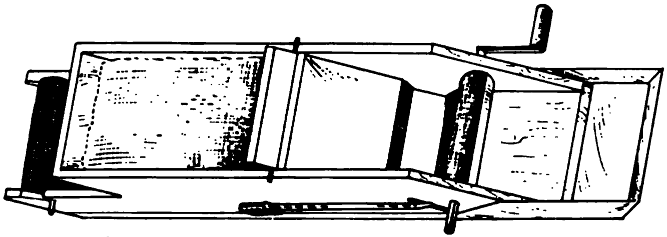


Fig. 148.—Pattingson's plaster bandage rolling machine used at Mayo Clinic. (Viewed from above.)

The crinolin roll is first "squared" at the end, then as the bandages are cut, the frayed edges are carefully freed of the threads, which immediately form the side of the bandage. This precaution prevents the hands of the operator becoming entangled in a useless mass of threads, as he attempts to apply the dressing.

The plaster of Paris is next added to the bandage. This can be done either by hand, or by using some instrument especially made for this purpose. One of the best which I have had occasion to observe is that employed by Pattingson (Figs. 147 and 148). He does not permit us to give this instrument in detail, but in the main it consists of a rectangular tin-lined wooden box, so arranged that the crinolin is drawn from a spindle at one end of the box, through the plaster to the spindle at the other end. The proper proportion of plaster deposit is automatically regulated by a sliding gate in the middle of the box, which is accurately set and held in place by a side pin so that it arranges that the meshes are exactly and uniformly filled with the plaster. A metal weight attached to a curved tin which supports the roll forces the bandage to be rolled at the proper tightness. This latter is very important, since a bandage too tightly rolled does not absorb the water readily, and one too loosely rolled does not retain the plaster.

A small metal pan, which catches the excess of plaster as the bandage revolves, is retained at the end of the box. The spindles are so arranged that by moving a special board, any sized bandage can be rolled.

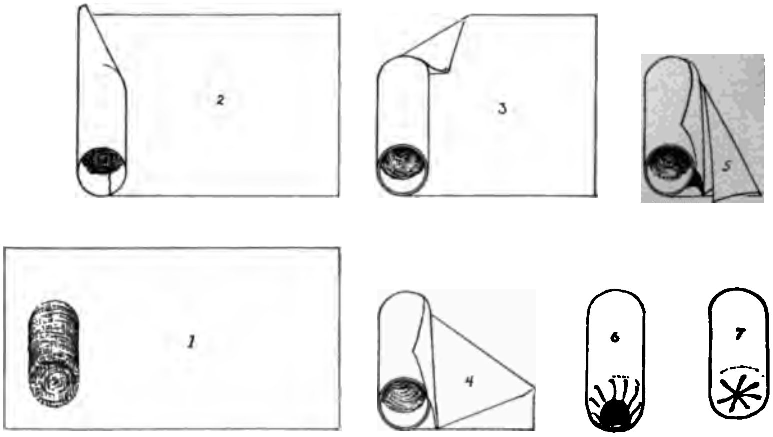


Fig. 149.—Pattingson's scheme for wrapping plaster of Paris bandages in tissue paper.

1. Bandage placed to the right of the middle of the tissue paper.
2. Beginning the roll.
3. Turning in the side.
4. Showing in detail method of turning in the side.
5. Advanced steps turning in the side.
6. Almost completed—crumpling in the end.
7. Completed.

When the bandage is completed, it is removed, and rolled firmly backward and forward under the edge of the hand, which doubly insures uniform distribution of the plaster. The terminal extremity of the bandage, having been encased in the plaster, is pinned to the body of the bandage.

When bandages are rolled by hand, the crinolin bandage is dragged over a heap of plaster of Paris as wide or wider than the width of it and as the roll of the plaster bandage is begun, plaster is sprinkled on the upper, exposed portion of the crinolin, in order to equally thoroughly impregnate it as the lower side is already well covered by its contact with the plaster lying under it. The roll is made loose and even, the process being best carried out on some hard surface at the foot of the heap of plaster.

In order to prevent the bandage from absorbing moisture from the atmosphere, and thereby rendering it useless, Pattingson rolls the bandage in a good grade of tissue paper as in Fig. 149. The paper which surrounds the bandage is so arranged that only one end remains open, to be closed later, by a twist of the paper. The completed bandage then is placed in a tin box in a dry place and kept in readiness for immediate use.

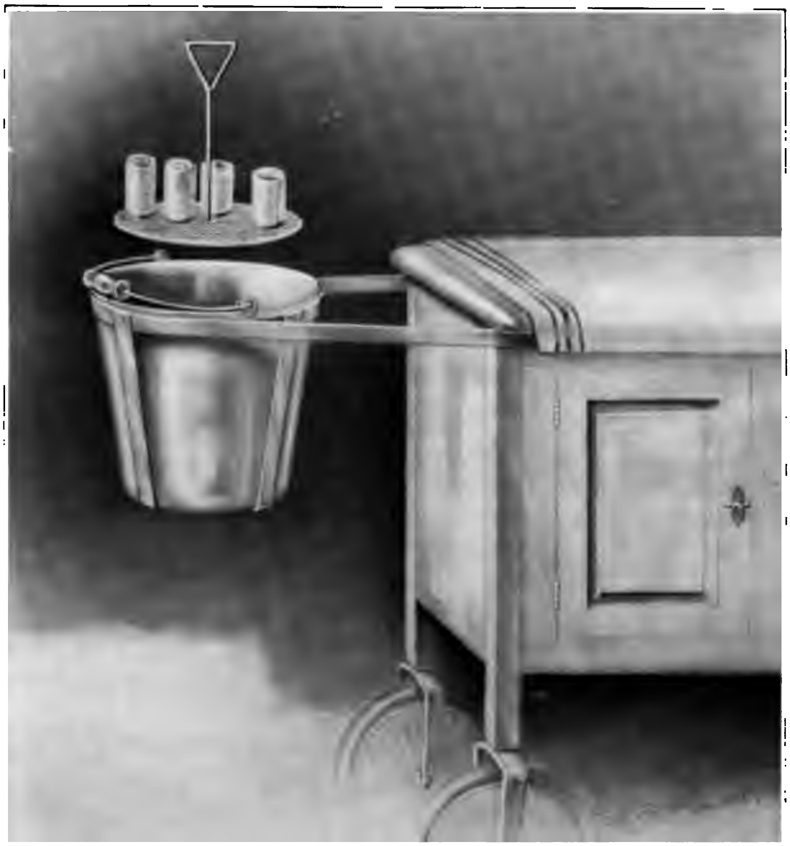


Fig. 150. A device for immersing plaster of Paris bandages.

The paper is held in place by a small rubber band around the roll. The wrapped bandages are now stored in tightly covered tin boxes, located in some dry place, where they are kept ready for use. As soon as they are required, the number necessary for completing the dressing is brought out, and placed near the bucket of water in which they are to be immersed.

In wetting the bandage, preparatory to its immediate use, we do not remove the paper, but tear away the ends, so as to allow free access of water and at the same time allow no plaster to escape. The bandage is immersed slowly, and is then held beneath the surface until all bubbles have ceased to appear, and the original hard roll is soft and pliable. It is now taken from the liquid, and the excess gently squeezed out, by compressing with a hand holding each end of the bandage. The paper is at once removed, and the bandage is then ready for use.

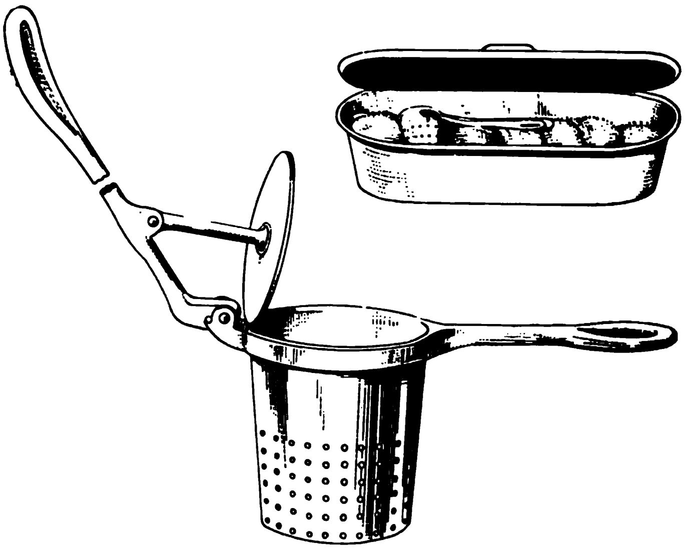


Fig. 151.—A device for expressing water from plaster of Paris bandages.

Henderson, at the Mayo Clinic employs a readymade wire stage (Fig. 150) supported by a long rod which he uses to immerse his bandages. This is a convenient contrivance, when a large amount of such work is required, but ordinarily the hand alone is sufficient for this purpose, or a potato-masher may be employed as is done at Rochester (Fig. 151).

Regardless of the method, however, immersion should be so timed that a bandage is kept ready for instant use, so as not to delay the operator.

The water which is usually employed is warm, and without the addition of salt, alum, sugar, etc. In cheaper grades of plaster, such chemical adjuvants are found useful in bringing about quicker setting, but with the high grade dental impression plaster, this is unnecessary.

When the floor, table, and surroundings, have been adequately protected by newspapers, the patient is placed in position, the skin powdered, and the tricot applied. After the bony prominences have been protected with heavy felt or cotton, the plaster is then applied. Care must be taken not to use too much padding, as this, at times, interferes with the firm support of the bandage.

Unfortunately, this dressing is most often required in patients who are bedridden. It is always a matter of more or less importance, as to what method is best pursued in getting the patient in position for the application of this important dressing. In cases requiring a spica of the thigh, including a dressing also for the body and limb, I have found the following procedure a very good one: the patient is taken from his bed and wheeled to the operating room, where he is placed upon the operating table. When proper precautions have been taken so that he does not become chilled, he is brought well down, so that his lower limbs extend off the table, and are supported by an assistant. A homemade plaster box

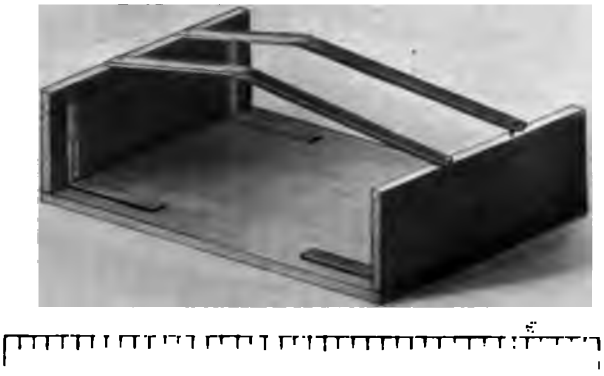


Fig. 152.—A convenient box for supporting patient during application of plaster cast.

is placed under the body. Further support than this is deemed superfluous.

The plaster box, which is the secret of good support in such cases, and one which we employ, was devised by Blair. It is simply a wooden box made of timber 1½ inches thick. It is 24 inches long, 20 inches wide, contains no sides or top, but the end pieces are 8 inches high. On the surface of the end pieces, and near the center,

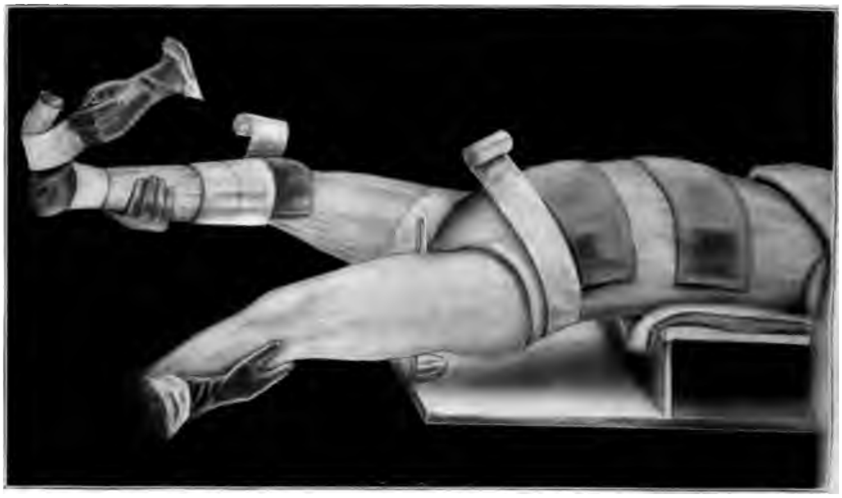


Fig 153.—Apply tricot and felt as preliminaries to plaster cast.

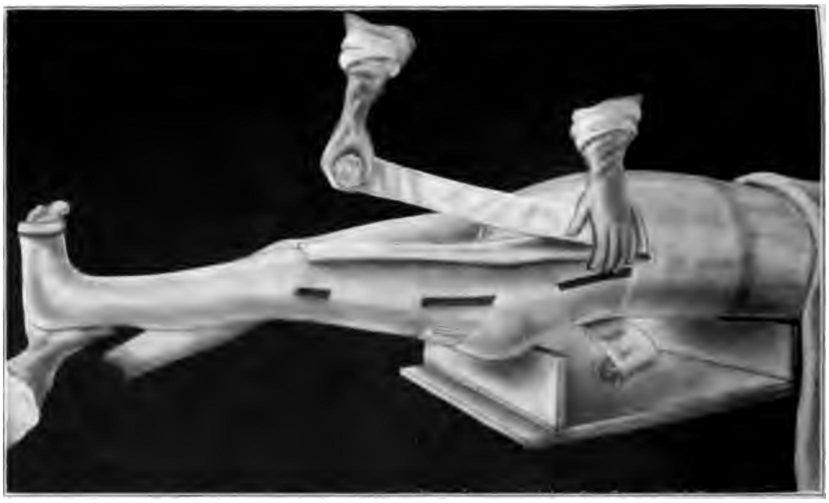


Fig. 154. Applying plaster cast with reinforcement of iron strips.

are located two iron supports for the two iron strips (Fig. 152) which bear the weight of the patient. The iron strips are 2 inches wide, ¼ inch thick, and are malleable, so that they can be bent to fit the curve of the patient's back. The box as usually employed is shown in Fig. 154 though in some cases it can be turned over as in Fig. 153 and a metal support given the hips. I have found this last method not nearly so efficient as using the box alone.

In cases requiring a cast of the leg only, this may be supported by strips of muslin bandaging, which are attached to iron piping, located directly over this bed and patient. It is held in place by two wooden supports, strapped to the bed. When the cast has been made, the muslin is cut, and the defect closed by a few turns of the bandage. This method is very efficacious in handling large patients, when one is short of help. It is not so convenient when the hip and body are to be encased in the cast. However, with the plaster box placed under the patient, this procedure could be carried out, even in bed, though not nearly so efficiently as when the patient is taken to the operating table.

The skin, previously thoroughly cleaned, is now sprinkled with talcum powder, and then covered with seamless tricot hose. This elastic material can be secured in any width desired, and can be stretched to snugly fit any portion of the body. When it is necessary to cut the tricot here and there, to perfect the fit, the several parts are held with adhesive. Heavy felt is now placed across the abdomen at the highest point reached by the plaster, and another, extending over the anterior superior spines of the ilii. Others are placed over the trochanters, the knee, around the heel and ball of the foot, as in Fig. 153. Directly under the top in front a pillow, roll or other filling may be used to prevent too tight application of the bandage in this region, which would embarrass respiration, and cause gastric discomfort. The pillow roll is removed at the close of the procedure.

The operators are protected with gown and rubber gloves. The plaster bandage, as described above, is taken and rolled firmly, but not tightly, over the areas to be covered. The bandage is not allowed to wrinkle, and each layer is so placed that it lies flat. Reversing the bandage is unnecessary. The plaster is kept smooth by frequent rolling with the hand throughout its application. In applying the bandage as shown in Fig. 155, it will be necessary to give the same amount of weight to the hip opposite to that covered with the bandage, or else the patient will slip off the box. This is accomplished by holding it down with the hand and at the same time the limb is held parallel with the affected one which is abducted and slightly bent, depending on the condition for which operation was performed.

As the application of the bandage proceeds, supports are placed at the sites most likely to break with muscular movements. This is accomplished by means of heavy wire, wood, or iron strips, bent to suit the individual need. In addition, further support by folding the bandage on itself, as in Fig. 154 and then placing it at the desired points, is very efficacious. Fig. 154 shows a strip already in

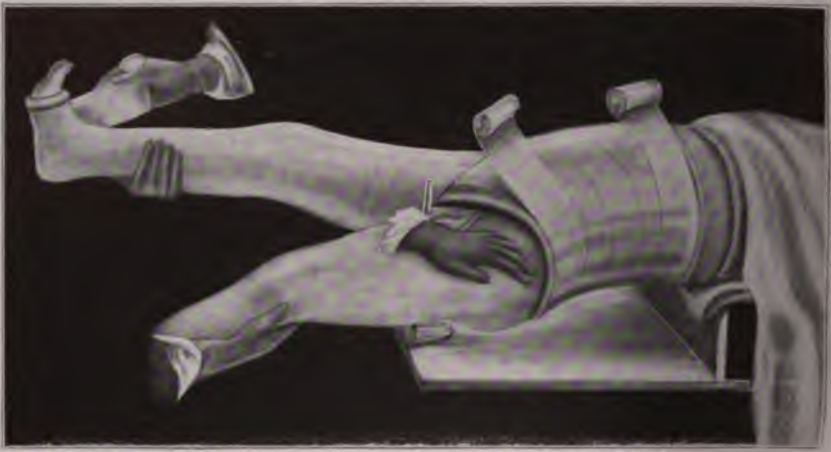


Fig. 155.—Using counterpressure on the healthy thigh.

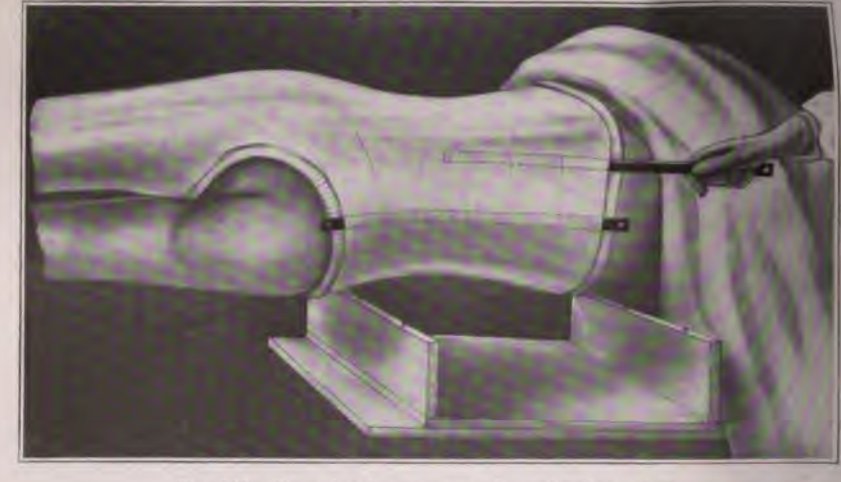


Fig. 156.—Removing iron supports from the plaster box.

place posteriorly, in addition to the iron strip and another fold of plaster being prepared for use elsewhere. As the bandage nears completion, the tricot, which is purposely left long, (Fig. 153) is turned back over the plaster and secured by additional folds (Fig. 155). The completed bandage is light, well supported with strips of bandage and iron bars, also the skin protected along all edges by layers of felt or cotton, which is covered with tricot, as shown in Fig. 155. The trimming of the bandage takes place on the table while the plaster is drying and is still soft, and before the tricot is turned over the edges. Otherwise this procedure is postponed until the patient is off the operating table, and the cast is dry: then upon wetting the part to be trimmed with plain warm

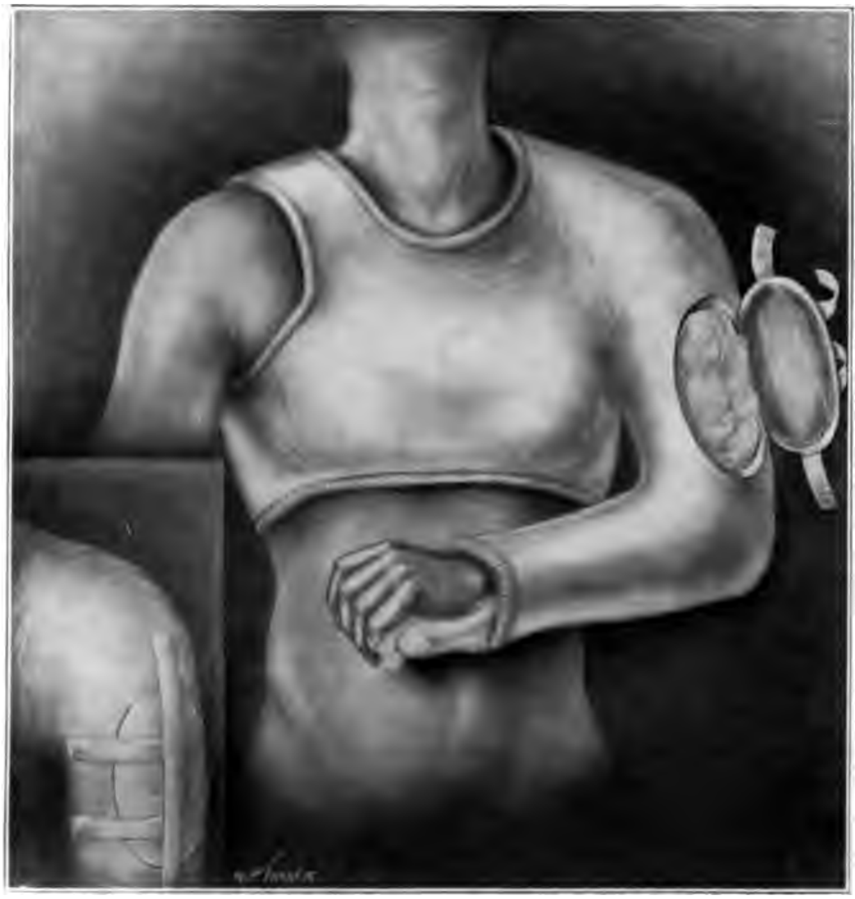


Fig. 157.—A fenestrum for dressing the wound.

water or water in which a little acid (acetic) has been added, the cast can be easily cut with a sharp knife. The tricot is then pulled over the cut edges and fastened with adhesive, running lengthwise with the turns of bandage.

The iron bars of the plaster box which supported the patient on the table are removed as shown in Fig. 156 just as soon as the cast becomes hard enough to keep from breaking when these are taken out.

Fenestra, as shown in Fig. 157, are made after the cast becomes hardened. The plaster cut from these areas is strapped with adhesive, and held in place. Casts cut to relieve tension, are also strapped with adhesive plaster to hold the parts together.

In applying the initial layers of a plaster of Paris bandage, the same rules as regards any bandage (concerning the prevention of eschemia, venous stasis, etc.) must be observed. In addition, the pressure from this unyielding covering is apt to produce necrosis, gangrene, etc., so that the bony prominences can hardly be too critically watched. Any pain complained of must be carefully looked into, and extra fenestra cut if necessary to relieve the pressure and pain. Neither the toes nor the fingers should be incased in such bandages, and when an extremity is so fixed, most careful attention must be given these digits, as cyanosis and coolness are the first indications of the bandage being too tight. The position which the patient will maintain in the cast is assumed at the beginning of the application, and he is held in place by competent assistants. Failure to rigidly enforce this rule often causes the bandage to be applied incorrectly, which is followed by breaks and discomfiture to the patient, necessitating a reapplication of the dressing.

A description of the various kinds of plaster bandages, and the indications for their use, is not deemed proper in a work of this kind, but I should like to call attention to the low hip immobilizing cast, which is sometimes employed in old people.

A high dressing tightly binding them around the upper abdomen can not, at times, be tolerated, and in such cases it is necessary not only for the comfort of the patient, but also for his actual safety, that such means of treatment are not insisted upon. In these cases, where such measures are necessary, a low cast is applied, one which extends to just below the umbilicus, and above the knee. The cast is made as described above, but is firmly supported by one wire around the waist, and outer side of the leg, and one wire, bent so as to follow the curve, at the lower portion of the cast, and extending on the inner side of the thigh. The wire is incased in the folds of plaster so as to avoid injuring the patient or pushing through the bandage on the outside.

Another bandage is that employed by Henderson for immobilizing

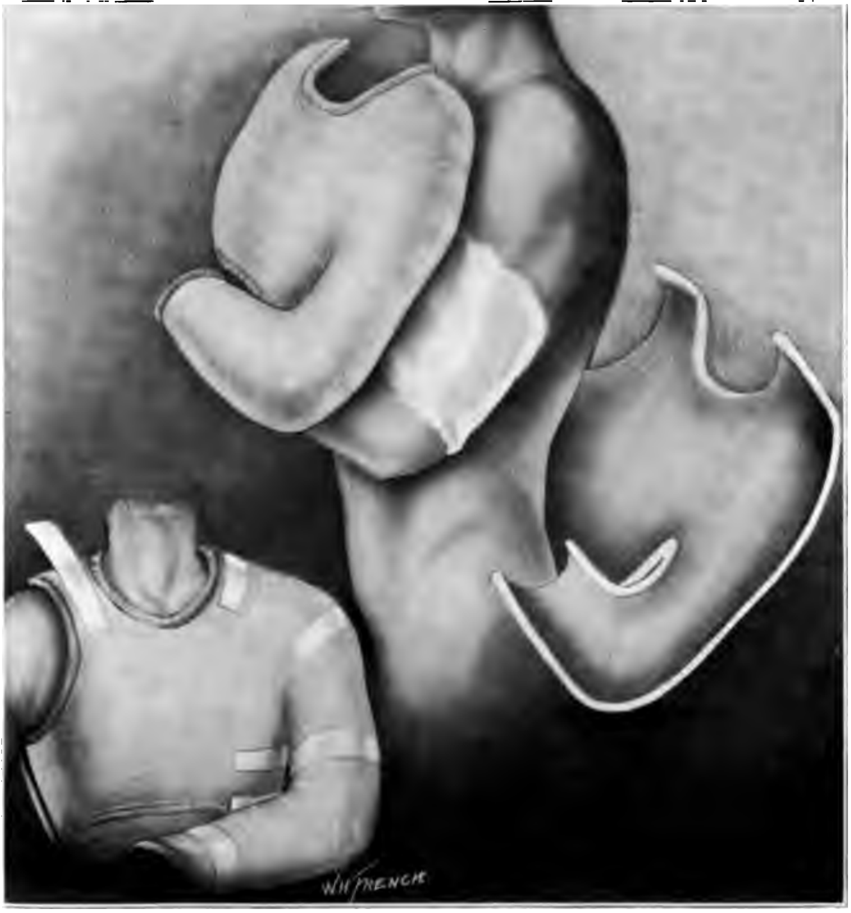


Fig. 158. A plaster cast split for temporary removal.

the arm and shoulder after transplantation of bone for ununited fractures of the arm. The cast is applied *before* the operation, with the patient in the standing posture, which insures its perfect fit and avoids the usual dangers attendant upon such dressings. The bandage is shown in Fig. 158. A temporary dressing is put on the arm to be operated, the same size that is to be used following the operation. The cast is made over all, and is allowed to stay in place until it hardens. Then the plaster is wet along the line of incision, and the cast cut through, dividing it into two equal halves, and is removed, as shown in Fig. 158. A fenestrum is cut over the operation site and held in place by adhesive. Immediately after the operation, and as soon as the wound is dressed, the two halves of this cast are placed around the patient, and held together with strips of adhesive, as in Fig. 158. Such a dressing permits the patient to be up and around very soon after the operation, without the slightest danger of displacing any bony fragments from movements of the arm.

The dressing is light, durable, and covers a small portion of the chest only, which prevents any interference with respiratory movements. The fenestrum permits change of dressing whenever desired. If, for any reason, discharge issues from the wound embraced in the cast, the edges of the fenestra are covered with collodion, which prevents moistening, and therefore softening of the cast, which would soon defeat the purpose for which it was originally intended.

The drying of the cast is accomplished by simply keeping it uncovered. As soon as the patient returns from the operating room, measures are taken to carry out this procedure. If it does not then dry fast, an electric fan is turned on it, or hot bags of salt placed around it, which drives away the moisture.

In removing the cast, the patient need not leave his bed; this is protected by rubber sheeting, and the floor with papers. Along the line of incision, cotton strips, soaked in plain hot water, or hot water to which vinegar has been added are applied, and as soon as there is a line of softening, the cast is divided along its course with a sharp knife, particular care being exercised that the patient is not injured by the knife. The underlying tricot, cotton, etc., are cut with a pair of bandage scissors, as shown in Fig. 98.

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CHAPTER L

THE ABDOMINAL BINDER

By O. F. McKittrick, St. Louis, Mo.

The role which abdominal supports play in the surgical convalescent has always been an uncertain one. The tendency among most operators is to discard them altogether, a practice which can never meet with universal approval, since there are certain classes of patients whose physical needs demand their use. Like all questions involving human infirmities, one rule will not apply to every individual, and the indiscriminate application of an unyielding idea, renders it unsafe. However, it is generally observed that the first few days' treatment of the incised abdominal wall is approximately the same among the majority of operators, and the variance of opinion concerning this subject is, in the main, directed toward the later protection to be given it.

Immediately following the completion of the sewing necessary to close the abdominal wound, gauze (20 x 20 mesh to the inch) is placed over it, either flat or fluffed, the amount to be determined according to whether or not the wound is drained. A layer of cotton batting, or a pad made of cotton batting, and covered with gauze, is placed over the flat gauze, which covers the wound; the pad is now strapped with 2 inch adhesive, and the patient placed in bed. This dressing is popular in many of the large clinics. The adhesive, however, gives considerable support, if used in 4 inch strips, and applied well around the body on both sides. There is some danger of such binders coming off, thereby exposing the wound to infection; otherwise they are inexpensive, easy of application, do not restrict respiration, or any of the body movements, and being light and cool, are especially comfortable in summer.

It has long been a practice in hospitals throughout the country, however, to apply a cotton domestic binder, as in Fig. 159 in addition to the previously mentioned dressing, and in many cases, the dressing without the adhesive straps. The binder is first pinned tightly up the front, and the slack at the sides is then taken up by using the pins, as in the illustration. I feel that, in many cases at least, such extra precautions could be easily dispensed with, especially in those cases which do not fall into the class of individuals to be suggested as favorable candidates for such treatment. The support which the additional covering adds to the properly applied adhesive, is not sufficient, so long as the patient remains in bed, to warrant the unnecessary discomfort which it sometimes entails. Some hospitals employ perineal straps to prevent the binder from slipping upward, and thus exposing the wound; these straps at times give no end of annoyance.

In clean wounds, the dressings are not disturbed, except to make sure the wound is healing normally, until the stitches are to be removed. In drained wounds other measures must be employed, in order to allow frequent dressings. In such cases the usual dressings are employed, but the adhesive is drawn tightly over the pad by means of gauze strings, and tied. The adhesive is then placed well under the back, usually three strips three inches wide, and so arranged as to pull evenly with the strip on the opposite side. In placing the gauze string, care is taken that the strip is made long enough to come up well over the dressing, and in line with the one on the opposite side. The two parts of the adhesive are stuck together, so that the free end extends below the lower portion of the pad, which prevents its sticking to the dressing. The wound with such a covering can be dressed frequently without disturbing the patient, and at the same time, gives good support to the abdominal wall.

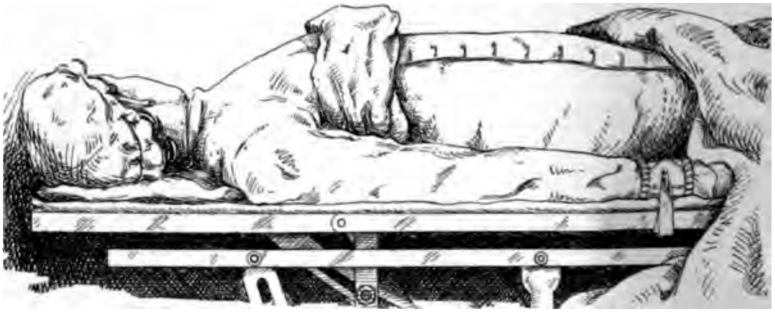

Fig. 159.—The ordinary immediate abdominal binder pinned on in the operating room.

The abdomen receives no further protection, so long as the stitches are in place, and the patient remains in bed. As soon as the stitches are removed, usually within ten days, in wounds healing by first intention, more attention must be accorded the abdominal wall. This, however, is not urgent until the patient is allowed to sit up. Crossen[1] as a matter of routine, applies boric acid powder to the wound and then, having placed a flat piece of gauze over it, he applies an adhesive binder to the lower abdomen, which gives ample support to the healing wall. The strips of adhesive which form the support are two inches wide and are smoothly applied with moderate tension, from below extending upward. This maneuver prevents unnecessary wrinkles in the binder, and tends to push the abdominal contents upward. Such a procedure takes all strain from the abdominal wound and insures against its rupture, either in whole or in part, during any sudden increase in intraabdominal pressure. Over the adhesive is placed a pad of cotton batting; this in turn is held with the binder. The adhesive support is worn for about one month, a straight front corset having, in the meantime, been adjusted over the dressing, worn during the daytime, and removed at night. If, for any reason, the wound is to be inspected, the portion covering it can be removed, and the abdomen restrapped.

The rules which we observe in applying an adhesive support are those outlined by Soper[2] in the use of his abdominal support for gastroptosis. These, in the main, imply that the first strips applied, i.e., the "X" strips, are first anchored to the dorsal vertebra, and then directed so as to follow the lower margin of the ribs. The patient, being in the sitting posture when this maneuver is accomplished, now lies flat on the back. The abdominal contents are pushed up, and the strips continued across the abdomen, one at a time, to be attached at the sides in the region of the inguinal ligaments. The cross strips are now placed, beginning at the anterior superior spines of the ilii. In patients whose operations did not require an abdominal incision, i.e., those in whom all work was accomplished through the vagina, the Soper support, which is a modification of that devised by Rose, can be worn without the additional coverings as employed in laparotomies. Such a support is not burdensome to the patient, and it does not interfere with the routine habits of life. If the skin becomes irritated, the dressing is removed with a little benzine and after a few days is reapplied.

Except the dressing and possibly the additional binder, no further abdominal support is required during the two or three weeks the normal individual is recuperating from the operation.

As for the general use of abdominal binders, Mills[3] says there is no particular indication for them, but when they are brought into service they should be used selectively, for instance, in people with lax abdominal walls, due to great loss of weight, frequent child bearing, large abdominal tumors, such as the fibromata, multilocular cysts, etc., and especially in patients with very much fat or pendulous abdomens.

Occupations such as laborers who do heavy lifting or those who lead sedentary lives may require the utilization of abdominal binders.

Static conditions play a part in deciding when to use the abdominal support. Patients with round shoulders always have poorly developed abdominal walls, since the entire burden of standing is thrown upon the muscles of the back; the abdominal muscles being so little used, accounts for the lack of development of the abdominal wall.

The type of the individual must be considered. Those generally debilitated, or who are naturally of poor physique, especially require this treatment. Such patients lack general tone, and as a result there is a state of generally diminished tone in the abdominal muscles. Many women of frail asthenic physique have naturally a low digestive plane, and in such the viscera are abnormally low. However, the low position of the viscera *per se* in individuals not entitled to such visceral topography, is an indication for the binder.

Patients with the "enteroptotic habitus" of Mills are frequently operated upon. But there are other cases of gastroptosis or general visceral ptosis that are also seen here, and in such patients, especially, must attention be given to the artificial support of the abdomen. Normally, their peritoneal attachments of the viscera are slack, the organs being kept in position by the positive intra-abdominal pressure. This is maintained by the tonus of the abdominal and pelvic musculature. Any decrease in tone in these muscles produces a weakness which permits an increase in the abdominal cavity, and causes a decrease in the intraabdominal pressure, with a resulting pull on the peritoneal attachments followed by a fall of the viscera. Hertz[4] states that a decrease in the bulk of the abdominal contents, such as a diminution in the normal intra-abdominal fat, will also bring about the same result as the decrease in muscular tone, and general laxity of the muscles. At any rate, the conditions usually go hand in hand, and as Mills has said, the accumulation of a desirable amount of intraabdominal fat is greatly to be desired in these cases, where marked loss in nutrition as a result of the surgical condition is present.

The character of the wound is vitally important in deciding upon the use of a support. The muscle splitting incision of McBurney, very rarely requires support. Usually such wounds are covered with a collodion dressing, or supported with adhesive strips, and the patient allowed up in two or three days. The anatomic relations are not disturbed, and consequently there is very little danger of hernia. The rectus incisions when properly performed, require very little more attention than the McBurney incision.

Incision through the linæ alba, below the umbilicus requires greater support than the muscle incisions above. Here the pressure exerted on the abdominal wall is greater, and the wound does not receive the benefit of any muscular support. Wounds, however, made above the umbilicus, whether within this region or through the abdominal muscles, rarely require any support at all.

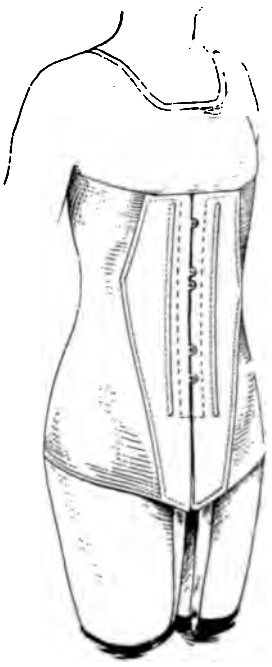

Fig. 160.—An ordinary straight corset. Front view. (Courtesy Just-Us Corset Co., St. Louis.)

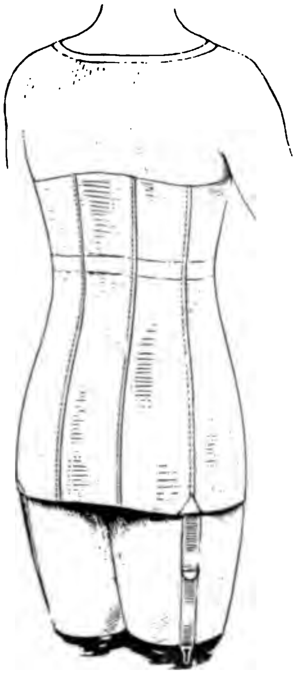

Fig. 161.—Ordinary straight corset. Back view.

Wounds which have been drained, and therefore heal by second intention, require longer and more intelligent care, than those which heal by first intention. Just how long binders should be worn in such cases depends entirely upon the type of individual, the length of time in bed, and the nature and size of the defect. In no instance does a wound demand a longer time than six months after the skin has closed over it to heal soundly. Binders should not be worn longer than this period, except, possibly in the very obese. In such cases, some sort of abdominal support will be necessary to be worn throughout the life of the patient.

Cases properly handled surgically as to direction of incision, accurate dissection, with perfect approximation, and cleanliness usually need no artificial support. No binder should take the place of a well-developed abdominal wall, but is applied to relieve the tension present on the wound. This tends not only to prevent a wide, thin scar, but also to some extent prevents hernia. It is usually worn, in those cases which need it, until the wound has thoroughly healed. This is ordinarily about four weeks, but longer periods of time are sometimes required depending, of course, upon the nature of the case. But in no instance should it be worn longer than six months, except in the condition as noted in the foregoing.

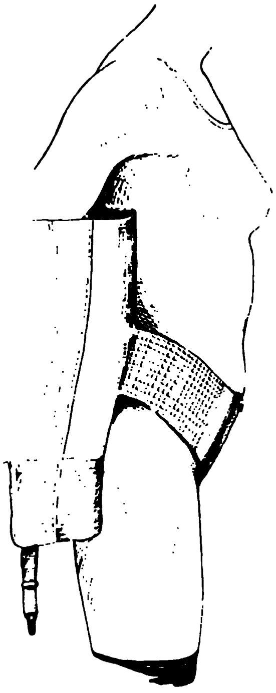

Fig. 162.—The athletic web corset. Side view.

Abdominal binders act as splints to the musculature, and too long continuance will produce atrophy from disuse. However, within the limits of time suggested, the support, that is, the weight of the viscera being lifted from the abdominal wall, allows the overstretched muscles to regain their tone, and the comfort secured from such devices allows the patient many times to eat more without fear of discomfort, and take more exercise. This not only tends to overcome the sluggishness of the intestines, but also to increase the amount of intraabdominal fat.

The binder is but a makeshift, in that it protects, and by protecting renders possible an opportunity for the development of the abdominal wall, through exercises. These are begun just as soon as the wound is thoroughly healed. The abdominal exercises are first started moderately, allowing the patient to raise her body from the flat position to the sitting posture without raising the heels from the floor. This is impossible for some patients to accomplish at first, but after many trials, these same persons carry out the procedure with ease. It should never be persisted in sufficiently to tire the patient; however, the feat can be performed several times a day, each day increasing the number of times the process is repeated. Further abdominal exercises should be followed out as suggested by Posse,[5] but for the first six months the abdomen should be protected during the exercise, by some abdominal pad or adhesive binder.

Many contrivances have been presented for use as late abdominal supports. I have found very little use for any of them. The most important feature to be observed in selecting a support, is that it applies itself to the lowest segment of the abdomen, and in so doing, fits closely to the inguinal ligaments, as near as possible to the symphysis pubis, and does not quite reach to the umbilicus. The abdominal contents are thereby pushed upwards, backwards, and inwards, which alone efficiently relieves the muscular strain. The apparatus should be as plain as possible, inexpensive, and at no time cause any discomfort to

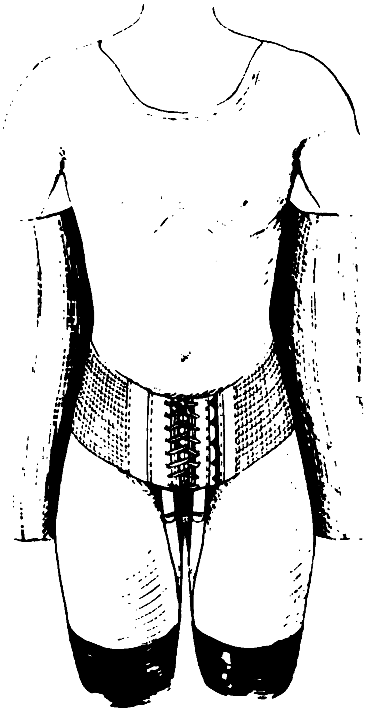

Fig. 163.—The athletic web corset. Front view.

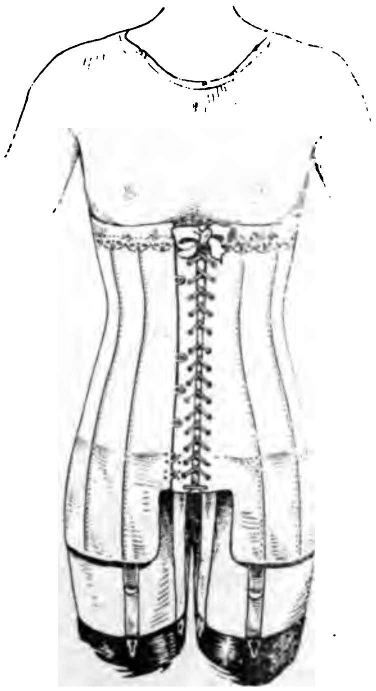

Fig. 164.—The athletic web corset laced. Front view.

In my experience I have found no support to surpass the adhesive strips further reinforced by the straight front corset (Figs. 160 and 161), when the patient is out in the world again, and performing the duties of life. Some patients find great comfort in the athletic corset, which is composed mostly of rubber web (Figs. 162 and 163). Such corsets can be worn indefinitely, without any injury to the abdominal wound, so long as the lower abdomen is pushed up while the corset is being laced from the bottom, and the abdominal exercises kept up. For cases with pendulous abdomens, the very obese, or the visceroptotic, I have found that best results can be obtained by having the patient fitted with a corset most suited to her build and size. In such corsets some insert a rubber web support, which is attached to the corset. The added elastic support fulfills every requirement, and yet the patient is not conscious of the necessity of wearing an abdominal binder for her condition. The belt is so adjusted that it unhooks as does the corset, and very little trouble is thereby entailed. This insures its more frequent use by the patient. At night no support is worn, the corset being utilized during the time the patient is on her feet only.

In men, the adhesive support of Soper has proved amply sufficient.

All cases requiring the use of abdominal supports should see the surgeon occasionally, to make sure that the supports are carrying out the purpose for which they were intended.

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[2] Soper: Jour. Mo. State Med. Assn., January, 1912.
[3] Mills, R. Walter: Personal communication.
[4] Hertz: Pract. Enclyp. Med. Treat., 1915, 323.
[5] Posse: Special Kinesiology of Educational Gymnastics, p. 168.

CHAPTER LI

EXERCISE AND MASSAGE

By F. H. Ewerhardt, St. Louis, Mo.

In the consideration of the after-treatment of operative cases it seems timely to incorporate in the plan physical measures, which, if properly applied, will stimulate repaired processes. Such agencies as massage, remedial exercises and hydrotherapy will here receive thought and attention. These measures have, until lately, received very little consideration at the hands of the medical profession; little or no thought was given them by the medical school curriculum. Consequently most surgeons have but a passing knowledge of its technic, physiologic effect or therapeutic application. Scientific research and clinical experience have, however, placed it on a rational basis. Massage has gained recognition as a result of the labors of Lucas Championneire of France, who was the first to champion massage and manipulation in the treatment of fractures; Sir Wm. Bennett of England, Mezter of Amsterdam, Zabludowski of Berlin, Peter H. Ling of Sweden and later Graham, Weir Mitchel and W. K. Mitchel, Jacob Bolin, Kellogg and others of America. Among the pioneers in modern hydrotherapy the foremost was Winternitz of Germany who was followed by Brandt, Ziemssen, Schott and Fleury in Europe, and Kellogg, Pope, Pratt, Baruch and others in America. In the field of medical gymnastics we turn first to Sweden, where Peter H. Ling founded his well-known system of Swedish gymnastics. Others to follow him were Enebuske, Nissen, Wiede, Kleen, Jahn and Kellgreen of Europe and Nils Posse, Jacob Bolin, McKenzie, Bucholz and others in the United States. Due to the labors of these men physical therapy has been incorporated in the medical curriculum of all the important European universities and is practiced extensively in most of the large hospitals in the United States.

This work has received a tremendous impetus during the past great war and is being employed intensively in German, English and French convalescent hospitals. It is not the purpose at this time to go into a comprehensive description of massage, exercise and baths, but rather to present an outline of those measures in a brief fashion, and yet embrace the salient elements in a manner which may be of best service to the busy surgeon. The mode of presentation will embrace the technic, the physical effect, and the indications.

Massage

General Discussion.—The question who should apply massage is, of course, a very pertinent one. Theoretically this should be the physician himself. His technical knowledge of anatomy and physiology coupled with the intimate understanding of the patient's physical condition and idiosyncrasies places him in a most favorable position for the performance of this work. Practically, however, this is not true because of the time-consuming element involved. Neither the general practitioner nor the specialist finds it a judicious division of labor to devote a great part of his time to massage and other forms of physical therapy, and it is well for the future of these measures that it is so, for otherwise it would not have reached its present high development. Massage, for instance, covers such a big field that men and women spend months of training in theory and practice in order that they may reach a degree of perfection commensurate with medical requirements. They are required to master to a fair degree a knowledge of physiology and anatomy and in addition possess a fair understanding of the pathology of diseases. The physician's part in the matter of massage is to possess a good working knowledge of its technic and its therapeutic application. It would be wise for him to have in addition a fair degree of skill so that he himself could, if necessary, perform the work, particularly in localized areas, when the labor involved would cover only a short period of time. In order to meet these indications, namely, to give the busy surgeon an opportunity of becoming acquainted with this subject and be able to intelligently prescribe and perform the work himself if necessary, a brief description devoid of exhausting details and repetitions follows:

Fundamentally, success following massage depends largely upon proper technic based on a knowledge of anatomy and physiology. A few general remarks, however, relating in some way or other to the subject are perhaps not amiss. Apparently trifling elements are oftentimes of sufficient importance to make or mar the success of the whole. Preferably the operator should be of genial and sympathetic disposition, yet firm in the correct performance of his work. He should exercise cleanliness with respect to himself as well as to the material with which he works. The surroundings should be quiet and inviting. It is quite discomforting to be massaged by an unkempt individual in an untidy, dark room. The operator, if not a doctor, should be extremely careful in discussing the patient's condition, treatment or prognosis. Patients are frequently prone to question the operator along these lines, which oftentimes results in embarrassing situations. The operator must ever remember his relation to the doctor; viz., to adhere closely to instructions, avoid discussing the treatment with the patient, and never offer advice.

Authorities agree that barring certain conditions, massage should be performed on the bare skin. Bucholz of the Massachusetts General Hospital makes this exception: "In cases of a septic hand where some granulations or superficial sinuses still exist, and where delay until these openings are all healed would cause adhesions and scars to become still firmer and stronger, kneading and friction may be done with benefit through a sterile sponge." Or, he adds, "in the case of a sprained ankle strapped with adhesive plaster."

It is always essential to keep in mind the healthy condition of the skin. If the stroking movements are to predominate, some lubricating material should be employed to prevent irritation of the hair follicles. For this purpose any of the following may be used: Cold cream, white vaseline, cottonseed, olive, cocoanut or mineral oil; or cocoa butter. If, however, deep kneading or friction is primarily indicated, a too thorough lubrication of the skin would interfere with the proper performances of the movements. The operator will then find it very difficult to properly grasp the deeper structures. In these cases common talcum powder had better be used or nothing at all. Again, parts that need to be massaged more than two or three times should not be shaved. If there is an abundance of hair, the parts should be well lubricated and, following the massage, well washed with alcohol.

Patients with skin diseases or fever should not be massaged. Fleshy, aged, or emaciated persons should receive only gentle treatments. In these cases the tissues are easily bruised. In acute inflammation, acute constitutional diseases and cancers, massage should not be given.

Physiologic Effect.—In the after-treatment of operative cases, massage may be used as an aid to Nature's way of bringing to the body cells nutrition and removing effete matter. Activity is the fundamental basis of all life, and equally important to the various structural units comprising the human body, the cell, tissues, and organs. In normal life the body cells are sufficiently nourished by fact of a constant supply of rich blood being brought to the parts, while the products of catabolism are washed away, the factors chiefly concerned in this procedure being the expulsive force of the heart, the elasticity of the arterial walls, alternate compression and relaxation of the muscles, fasciæ and joints, and the thoracic suction force produced by the negative atmospheric pressure in the thorax. Following an operation all of these factors may be, while in all cases some of them will be, affected. Depending upon the degree of immobility required of the patient, a greater or less degree of assistance is taken from the heart in its effort in maintaining proper circulation. The lymph flow too, as Starling has pointed out, is entirely arrested during rest. The effect of this is reflected unfavorably on the general bodily condition. To replace this loss is one of the chief functions of massage and exercise. If there is no acute inflammatory process, cancer or fever present, these measures are indicated in order to improve the general well-being of the patient. Massage is particularly in place in muscular and nervous exhaustion. It feeds muscle and nerve without fatiguing them; active exercise on the other hand, feeds, but at the expense of nerve force. Therefore at the earlier convalescent stage general massage may be employed. As soon as the condition of the patient permits, mild passive and later mild active exercise are useful, at first in a lying position and later graduating to a sitting, and finally to a standing position.

The effect of massage and exercise on the digestive organs reflects itself by way of the improved circulation, particularly by removing visceral congestion and through reflex influence upon the glands of the stomach and the intestines. Furthermore the intestinal mass may be caused to move along the colon by means of mechanical manipulation, and by increased peristalsis stimulation. Finally the general increase in nutrition creates a demand for an additional supply of nutriment which nature manifests by an increased improvement in appetite. In discussing elimination, it seems pertinent to mention the favorable effects of massage on the liver and kidneys. The skin also is made to functionate with increased vigor. This is effected by a direct stimulation of the sweat glands and reflexly by its influence upon the circulatory system, thus furnishing the skin with an increased supply of blood. Massage manifests itself upon the nervous system in a variety of ways, but no attempt will be made at this time to enter into these various channels. For our purpose, mention will be made only of its stimulative and sedative effect. For the former, vigorous friction and percussion movements are used, for the latter, slow and gentle stroking or kneading. Frequently bedridden patients are restless both day and night. For these cases a short stimulating massage in the morning and a sedative treatment in the evening would be an excellent procedure. A properly performed sedative treatment is usually followed by a peaceful repose and a satisfied feeling of well-being. Frequently patients fall asleep during its administration.

Massage improves the nutrition of muscles. Physiology teaches us that a muscle which is inactive is also poorly nourished, and we know that an inactive, poorly nourished muscle soon enters upon a condition of atrophy. Furthermore we have learned that it is best for a healthy muscle to functionate regularly to its complete extent. If this process is interfered with for too long a time, the muscle will shorten by adapting itself to its new mode of requirement. Massage and exercise would do much to prevent these untoward effects.

The effect of massage upon the red and white blood cells and hemoglobin is interesting. J. K. Mitchell of Philadelphia in his observations of thirty-five persons suffering from various types of anemia, some slight, others severe; some from toxic causes, others malnutrition and some from hemorrhage, noted that massage produces a general increase in the number of red blood cells and in about half the cases an addition in the hemoglobin. This result has since been frequently verified. The increase manifests itself one-half to one hour following the treatment and continues for several hours. While both white and red cells are found in large numbers, the whites show a relatively greater increase. Massage does not manufacture blood cells or hemoglobin, but merely puts into circulation those that have remained dormant in the system, particularly in the liver and spleen.

Technic.—The proper technic of massage depends primarily upon a knowledge of normal and pathologic anatomy and the correct performance of the various movements. These are not difficult to learn, but the finer movements, the delicacy of touch, and a high degree of skill can only be acquired through actual experience.

The simplest classification divides massage into four groups. We shall use the French terms because they are so universally employed.

Effleurage.—Effleurage consists of a stroking motion with the palmar surface of the fingers or of the whole hand. It has for its main object the emptying of the venous and lymph glands, the resultant suction force bringing more blood to the tissue. The movements should, therefore, follow the outlines of the muscles, beginning with

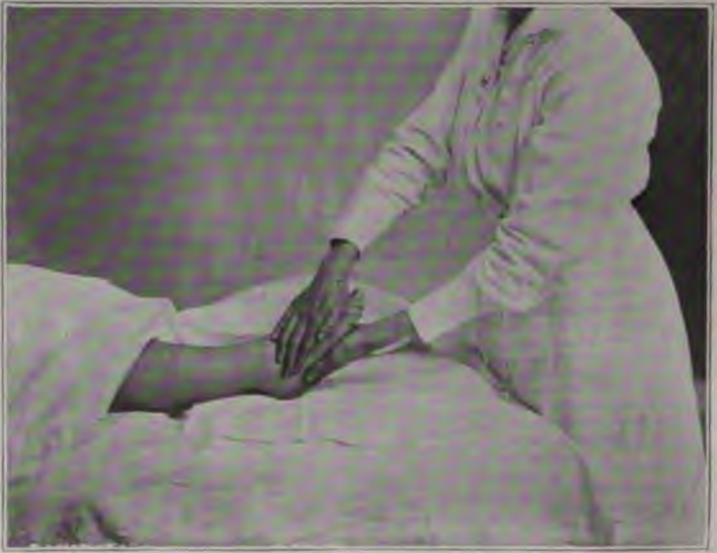

Fig. 165.—Effleurage, foot held firm with operator's left hand, firm stroking towards toes right hand.

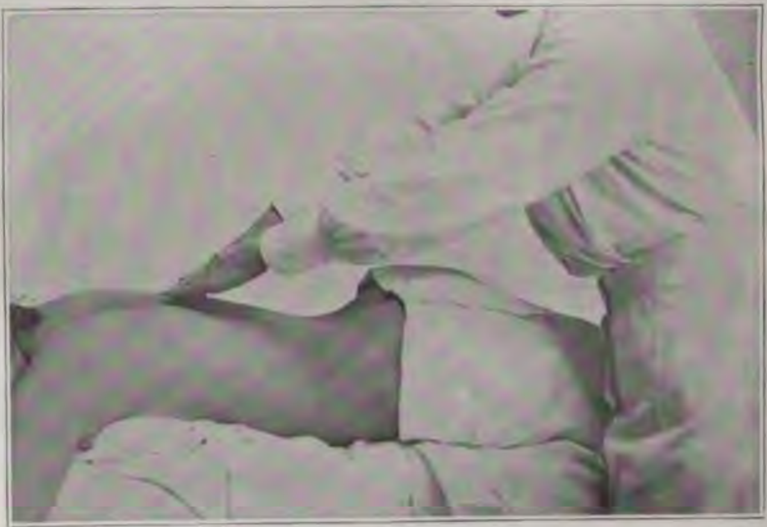

Fig. 166.—Diamond effleurage. Beginning at the coccyx apply pressure on both sides of the spine upward to the 7th cervical, effleurage by placing palm of hands on back, apply firm stroking motion downward to pelvis.

a gentle pressure at the insertion, increasing to its maximum intensity at the belly of the muscle and concluding with decreased pressure at the origin. The effort, where possible, should be made to surround the muscle with the whole hand, applying a grasping

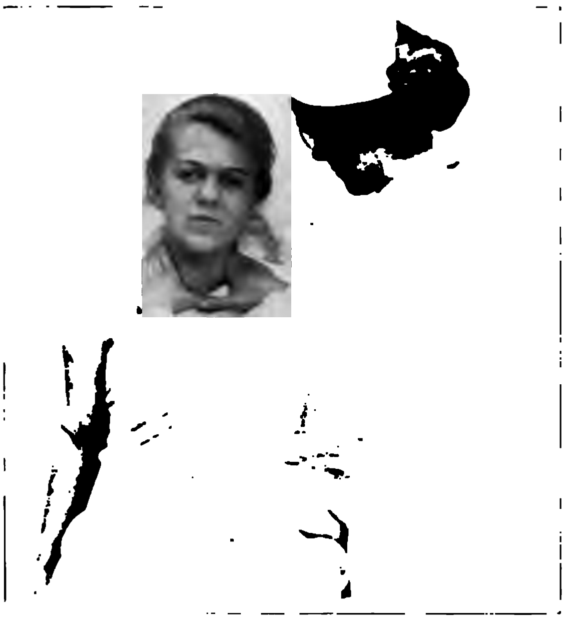

Fig. 167.—Draining the jugular veins.

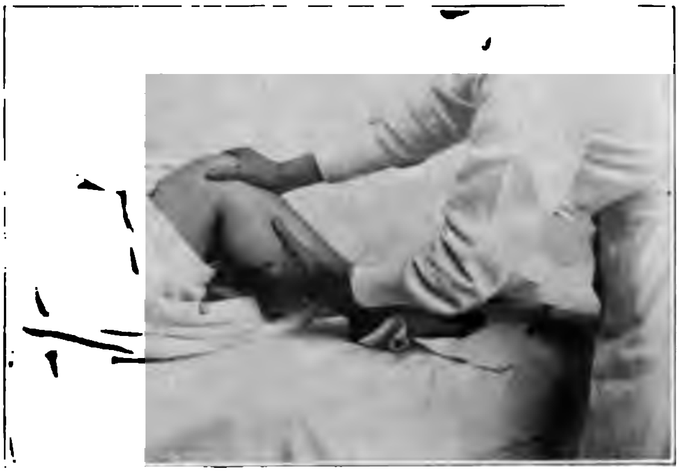

Fig. 168. Alternate wringing of the flexor muscles. Hold leg in position with right hand, wring the muscle with the left.

motion. On the trunk or upper thigh where this can not be done. direct pressure against the more solid and deeper tissues should be made. Effleurage should form the beginning and ending of every treatment and may be injected at any other time. It is particularly useful for the removal of exudations following fractures and joint disturbances. If instead of the above-described stimulating movement, a sedative effect is desired, the stroking should be very gentle with the tips of the fingers barely touching the skin in a centrifugal direction. It is this form of massage which is not uncommonly

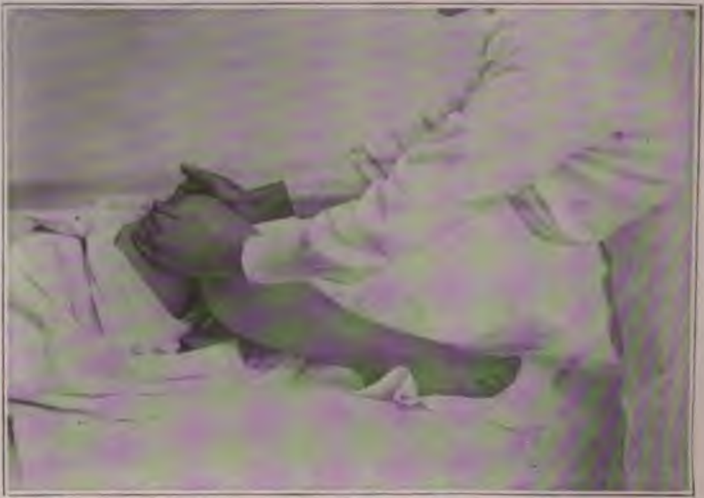

Fig. 169.—Kneading of the patella. Leg in a flexed position. Both hands cover the patella. Knead outward and upward.

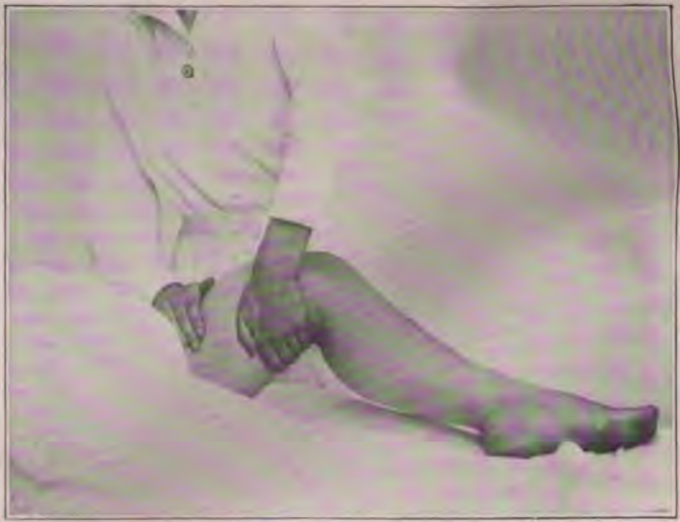

Fig. 170.—Alternate kneading of the flexors of the thigh, beginning at the upper part and working toward the knee.

followed by a restful sleep. It is indicated in cases of restlessness, certain forms of headaches, neuralgia and neurasthenic pains. (Figs. 165 and 166.)

Petrissage.—By this term is meant deep or superficial kneading

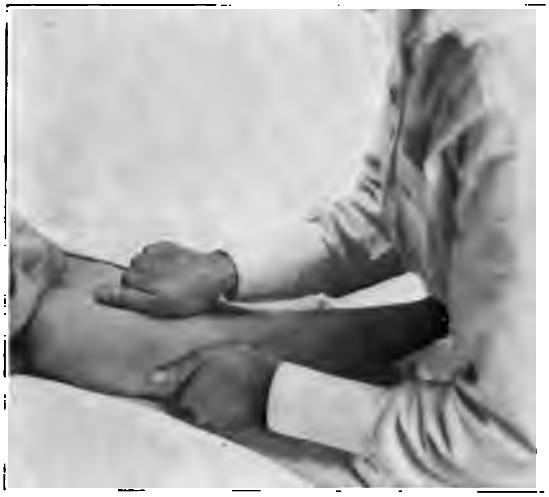

Fig. 171.—Pulling and pushing of the flexors and extensors of the arm.

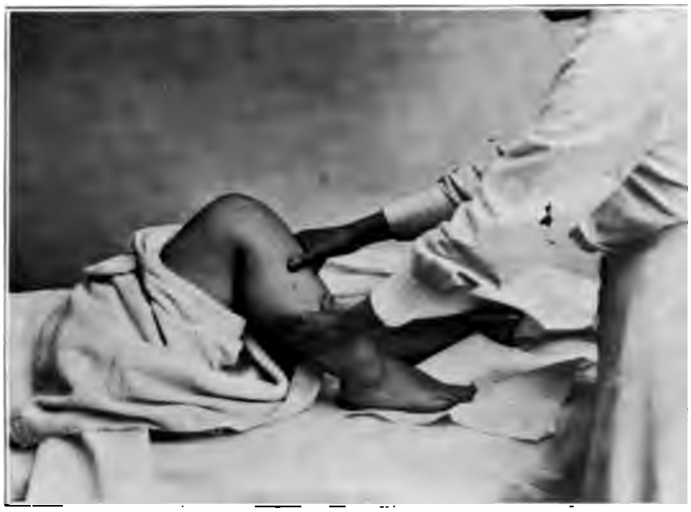

Fig. 172.—Thumbs kneading the anterior muscles of the leg.

of the muscles together with grasping, pinching, rolling, pressing and stretching of the underlying tissues. One hand may grasp as much tissue as possible, lifting or squeezing it, repeating this manipulation until the entire muscle group is covered. Or one hand may alternate with the other; or again, one hand may work on the anterior while the other on the posterior part of the limb. Again

Fig 173.—Anterior frictional kneading of the thigh alternate up and down.

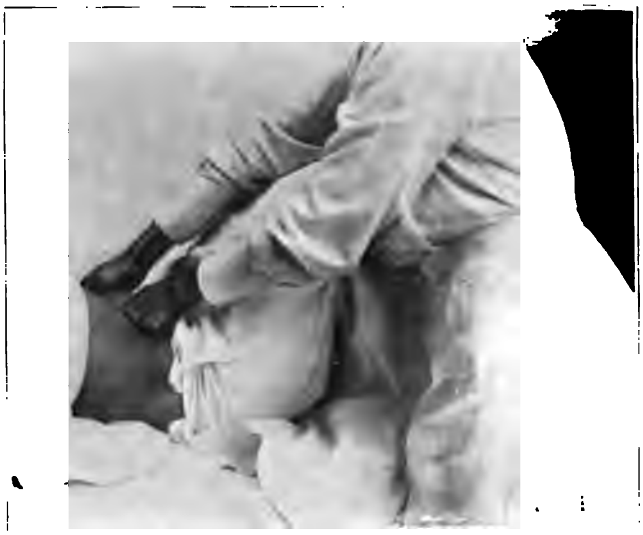

Fig. 174. Fist kneading of the small intestines. Place fists one inch above and to the side of the umbilicus, alternate knead down to one inch below the umbilicus.

the tissues may be caught between the thenar eminence of both thumbs and rolled against themselves or against the underlying tissues. Another type of petrissage consists in supporting a limb with one hand and grasping the fleshy portion with the other, push-

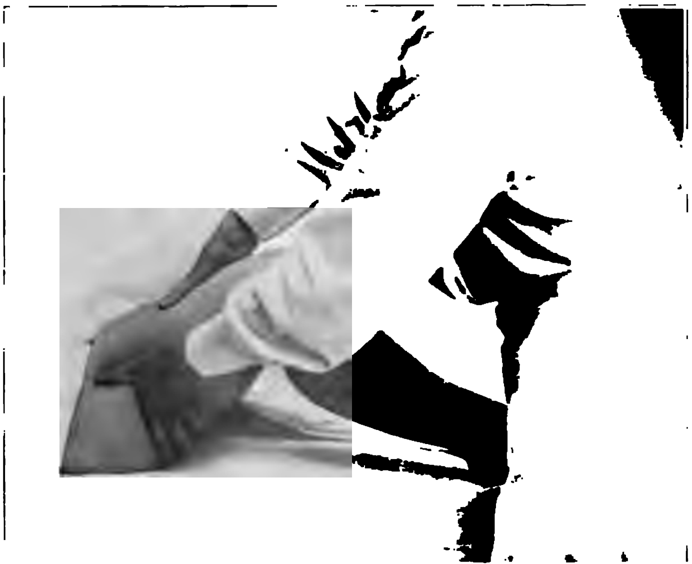

Fig. 175.—Circular muscular kneading of the thigh, beginning at the upper part and working toward the knee, place the hands firmly on either side of the thigh and roll the muscle around the bone.

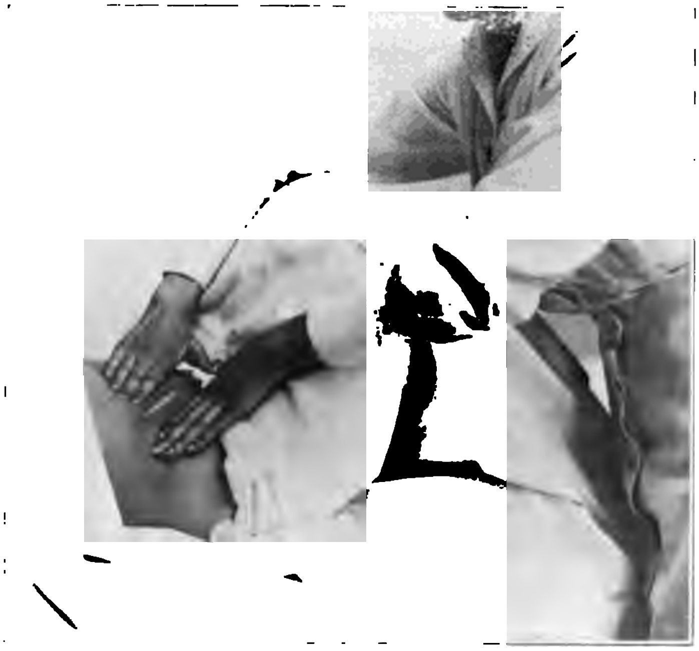

Fig. 176. Breaking up adhesions. Place one hand on the side of the scar and hold in position. The other hand is placed on the opposite side and rolls or pulls the tissues against the counterpressure.

ing and pulling it in the direction of the long axis. This procedure is especially useful in muscular spasm and the stretching of contracted tissues. Petrissage is a decidedly stimulating measure acting on all the vital functions. It brings about circulatory changes, improves muscle tone, serving very much as an active exercise. (Figs. 167-175.)

Friction.—This term does not signify merely rubbing over the skin which is a motion akin to gentle stroking, but instead consists of a series of rotary motions executed by the tips of one or more fingers, the thumb resting quite firmly on the skin and moving it over the underlying tissues. It is especially useful in loosening adherent tissue and therefore is employed a great deal in the treatment of abnormal joint and scar conditions. It also tends to relieve local congestion by lending aid in the forward movement of the venous and lymph currents. (Fig. 176.)

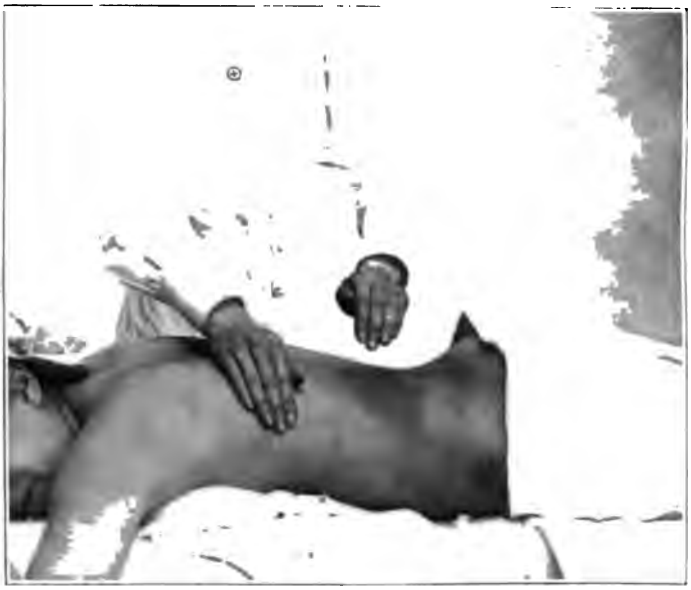

Fig 177.—Cupping.

Tapotement of Percussion, consists of a series of blows delivered with a flexible wrist to avoid bruising of the tissues. Various methods of percussion are employed:

(a) Clapping is performed with the palmar surface of the hand so shaped as to form a cup. The hands are alternately brought down producing a resounding effect. This serves as a stimulant to the skin (Fig. 177).

(b) Hacking is applied with the ulnar surface of the hand, the fingers being held rigid and close together or relaxed and separated. This is applied particularly to large masses of muscles and along nerve trunks (Fig. 178).

(c) Slapping is performed with the flat of the hand. This excites the peripheral nerve endings.

(d) Tapping is a measure executed with the tips of the fingers. It is used chiefly along nerve trunks, whenever the bone lies close to the skin or in scalp treatment.

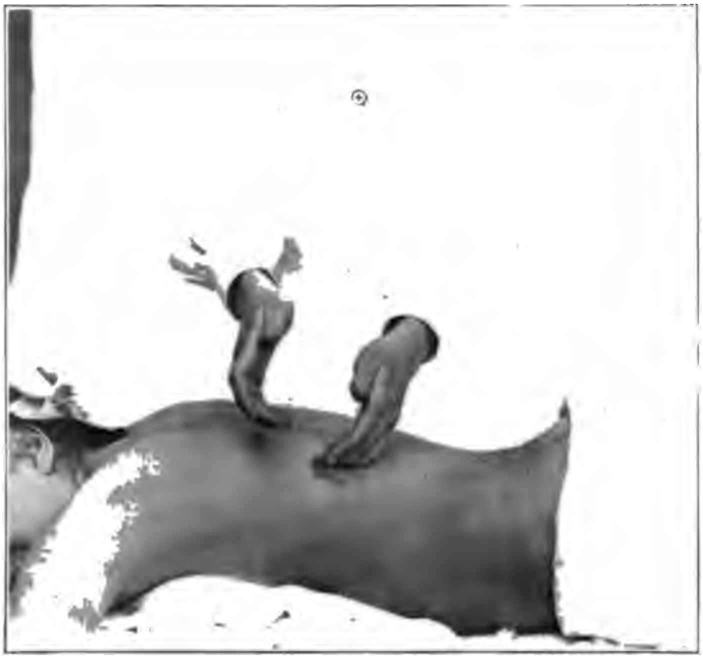

Fig. 178.—Hacking.

Vibration

Vibration may be transmitted to the body in a variety of ways all tending to produce either locally or generally a more or less rapid, to and fro motion of the tissues. Manually it may be performed by pressing one or more finger tips firmly against the part to be treated and executing rhythmic movements at the rate of from eight to ten times per second. The act may be localized or it may follow the course of a nerve trunk. This method, however, is very tiring on the operator and can be sustained for a short period only, for which reason various types of apparatus have been invented, some of which are very good.

Portable Apparatus.—The more general way of performing vibration is by means of an electrically propelled apparatus which imparts to the tissues a rapid rotary or lateral motion ranging in velocity from 1000 to 6000 per minute and even more. A variety of applicators are used in connection with the machines.

Stationary Apparatus.—The most popular of this form of apparatus is the vibratory chair, so constructed that the whole body, or parts thereof, if desired, may be treated at the same time. The oscillatory movements may be regulated as to speed and length of movement. There are various modifications of this type.

Shaking and Kneading Appliances.—The use of this type, as well as the chair just described, is almost entirely limited to institutional use. Their action approaches more nearly a mechanical massage than vibration. The trunk shaker is an apparatus which has attached to it an eccentrically revolving wheel. The patient standing in an upright position allows his body to rest against a belt attached to the wheel. The resultant action is a violent shaking of the body.

The mechanical horse acts by bouncing the riding individual at a regulated speed and distance.

The kneading table acts by means of four to six uprights which project through an opening in a table and operate on the abdomen of the patient lying prone. Here too the speed and distance of movements are adjustable.

Physiologic Effect.—The particular effect of vibration is general stimulation, causing rapid but small muscular contractions. At first the superficial blood vessels are contracted then dilated. If applied along a nerve trunk a diminished sensibility may be brought about, for which reason this method is sometimes used in connection with the treatment of neuritis and neuralgia.

Applied to the heart the pulse may be caused to beat slower but stronger. It has been used successfully in relieving muscular spasm, a fact first noted by Charcot who used vibration in the treatment of paralysis agitans.

The shaking and kneading movements are used principally in cases of obesity and constipation.

Exercise

Today exercise is regarded by the laity as well as by the profession as a synonym of health. No one agency in the whole category of the laws of personal hygiene has received such impetus as has that of exercise. Young, middle age, and old of both sexes indulge in it as never before. Public schools, colleges and even municipalities recognize its value and spend much money in its promotion. It seems therefore reasonable for the medical profession to consider this agency from the standpoint of therapeutics and add it to the present established methods of postoperative treatment. To gain a clearer understanding of its therapeutic value we classify exercise into various forms.

We speak of an active exercise as one which follows an effort of the will. It is voluntary on the part of the individual and may be executed with or without assistance.

A passive exercise is performed by an operator, or apparatus, on a patient without the latter's assistance or resistance and has no connection with the will of the patient.

Resistive exercises are performed by the patient, the operator resisting the active muscle becoming shorter. This is spoken of as positive concentric in action. Or the operator performs the movement while the patient resists, in which case the active muscle becomes longer, negative, or excentric in action. This latter form for instance, is used in cases where the muscles are still too weak to use concentrically.

Movements of skill are primarily active exercises involving the coordination of the nervous and muscular systems. It means educating the muscle to perform an act with the least expenditure of nerve energy and requires strict and concentrated attention. As examples may be cited the swinging of Indian clubs, fancy skating, walking a railroad track, or it may be of a more violent form like foil fencing, tumbling or tennis playing. When such an exercise is first begun, fatigue quickly sets in, because an unnecessary number of motor nerve impulses are being sent from the brain, not only to the muscles involved in the correct performance of the act, but to other groups as well, including often its antagonistic fellows. Furthermore a failure to send inhibitory impulses to the antagonistic group increases the disturbance of the normal neuromuscular mechanism so that there occurs a more or less irregular and haphazard contraction and relaxation of muscles producing an awkward exercise, not at all that whi [illegible] had willed to do.

The muscles soon tire and refuse to respond to the will because of the exhausted condition of the motor cells. Nerve cells fatigue quicker than the muscle cells which they innervate. Obviously, exercises involving such close attention are not indicated in persons already suffering from nerve exhaustion. For these patients passive motion, joint movements, and massage serve the purpose very much better, for here muscles are fed with new blood without brain expenditure. These latter measures, however, should be replaced as soon as the patient's condition warrants it, by mild active exercise, because the general physical effect of the latter is of greater value as a general body building measure than massage or passive exercise. Neither should exercise following a command, like marching tactics, or a new wand or dumb-bell drill be given in these cases because of the concentrated attention necessary. This is a valid reason why mentally tired school children and business men prefer playing games to formal gymnastics. Because of the great mental activity involved in this class of exercise they are termed educational. Oftentimes repetition of these intricate movements finally results in their performance with an increasingly less expenditure of nerve force because of properly directed stimulating and inhibitory impulses, and therefore are less fatiguing. They then become less educational in character and no longer stimulate the element of discipline. Applied therapeutically, an accomplished tennis player, following an illness, can more quickly resume his game with profit than the individual who is just learning to play.

Contrariwise exercises of effort involving decided mental action may be properly given to persons of sedentary habits, not of a too active brain, to whom active exercise is a drag even when in the best of health. Exercises of effort vary from a single act like lifting a heavy weight to a simple exercise frequently and quickly repeated, like jumping a rope, racing, and games of like nature. In a violent form of effort practically every muscle group in the body is involved even to the facial group. This has been so interestingly described by McKenzie of the University of Pennsylvania. Witness the drawn face of an athlete at the finish of a race. This form of exercise demands a great deal of nerve expenditure and should not be given in cases where it seems desirable to conserve nerve force. In this case we place most of our modern athletic performances like sprints, hurdles, the long runs, pole vaults and jumps; basket, hand, and foot ball. These exercises, however, are classified as acts of effort only so long as attempts at maximum intensity are made. If, for instance, a given run be covered at a minimum rate of speed, it becomes an exercise of mild or severe endurance, depending upon the distance run. The physiologic effect is decidedly different from that following an exercise of effort. Thus while a distance of several hundred yards run slowly would become an act of endurance and an excellent prescription for a boy with a so-called weak heart, it is decidedly contraindicated if the distance were run at maximum speed and thereby became an exercise of supreme effort. Because of a failure to appreciate these conditions many a young man has been denied mild athletic exercise by his doctor, which might have been of help to him. It is exercise of mild endurance which may be of particular helpfulness to physicians. They involve acts demanding a minimum expenditure of nerve force. Included in this class we place hiking, rowing, a mild game of tennis of not too keen competition, golf and noncompetitive swimming. Exercises of this type are very beneficial for strengthening the heart and general body building.

Mild exercises of strength constitute another form of activity well suited for the convalescent, for they require little skill and may be indulged in while the patient is yet in bed. Some effort at attention is necessary, but the essential requirement is to attempt as complete a contraction as possible. It is this type of exercise which increases the bulk of the muscle and is therefore used for general developmental purposes. Appropriate movements at the earlier stage might consist of arm and leg movements in the various directions, executed as either voluntary, active or resistive.

Physiologic Effect of Exercise.—No part of the body is more profoundly affected by exercise than the great mass of voluntary muscle. The effect is directed in a line of increased bulk and in an increase of strength and endurance, the former, however, not developing in direct ratio with the latter. One may, for instance, exercise the biceps until its maximum girth is attained, after which no amount of additional exercise will increase the circumference of the upper arm. The endurance and strength of it may, however, keep on growing towards a greater maximum. This is explained by the fact that active exercise will not only strengthen the muscles, *per se,* but also the nerve force causing its contraction. In others words, active exercise prompted by the individual himself is a force, and the only force, which causes an increased power and efficiency of the neuro-muscular apparatus, involving as it does for its execution the functioning of nerve cells situated in the seat of higher consciousness, the motor areas and elsewhere, the central nervous system, as also the muscle tissue itself. This is not true with respect to passive movement or massage. It is for this reason that we aim to treat paralytics by means of active exercise as soon as this may be permitted.

Through the muscular system, exercise powerfully affects other vital activities. The circulation is hastened and the lymph is propelled along its channels. Breathing becomes deeper and fuller, aiding thereby the return circulation, increasing the carbon dioxide output and the oxygen intake. The effect of exercise on the heart has long been misunderstood. McKenzie of Philadelphia has gathered data which seems to disprove the generally accepted thought that athletics are harmful to the college student. To be sure if untrained individuals with weak hearts are subjected to violent exercise the inevitable harm will follow. On the other hand observation and experience and research seem to give an abundance of conclusive evidence to the effect that athletics practiced under safeguarded conditions may be an excellent heart strengthening agent. The pulse rate and blood pressure rise quite decidedly and the heart increases in size but these return to normal in a surprisingly short space of time. This is even true with respect to the more violent forms of exercise like rowing, wrestling, marathon running, heavy lifting, and mountain climbing. The criterion as to whether the heart is capable of performing a given amount of work is found in the fact that following muscular exercise there will be a definite rise in the pulse rate and blood pressure and that these will return to the normal at the expiration of a given period, depending upon the amount of work done. In one of the British hospitals a covenient test is employed to determine the heart efficiency. A soldier is required to raise his body weight twenty feet in not longer than 30 seconds, e. g., running up a flight of stairs. He is considered as having a "good reaction" if his pulse and respiratory rate and blood pressure return to normal at the end of three minutes.

General Outline of Exercise Treatment for the More Common Indications.—Select at first a mild grade of movements and graduate to the more severe type. Exercise preferably twice a day and continue to a mild degree of fatigue, then stop. If physical conditions permit, it is well to follow the exercise with a mild tonic hydriatic procedure and a general massage once a day.

I. *For relaxed abdominal muscles* common with enteroptosis, constipation (except spastic type), puerperium, faulty posture, convalescence, etc.:

Lying position arms at side.

1. Head raising with rotation.

2. Trunk raising, chest leading shoulders back, with exhalation. Raise from 1 to 6 inches.

3. Leg raising first one then the other, 6 inches.

4. Same with knees flexed, later with resistance.

5. Knees flexed, abduction and adduction, later with resistance.

6. Bring flexed knees towards chest slowly, exhaling to prevent undue intraabdominal pressure.

7. Bring one flexed knee toward shoulder of opposite side.

8. Retract abdominal muscles as much as possible with deep chest raising and inhalation.

9. Keeping shoulders down roll legs and hips to opposite side. Later with knees flexed, then legs extended upward.

10. With hands on hips raise trunk to sitting position. Later hands on neck or arms extended upward.

11. See exercises on Hernia.

12. If used for enteroptosis, it is well to raise foot end of table 12 to 15 inches.

Sitting position on straight chair with feet resting on floor.

13. Alternate knee raising; later both.

14. Knee raising with abduction and adduction; later with both, and then with resistance.

15. Knee raising with alternate extension.

16. Extended leg raising with abduction and adduction.

Sitting on stool.

17. With legs fixed, or supported by nurse, incline trunk backward. Hands on hips, on neck or extended upward.

18. Same position as 17 with trunk circumduction.

19. Same as above with trunk twisting.

Hanging position.

20. From mild type of knee flexion to knee extension with abduction and adduction.

II. *Exercise to improve posture.* It is very important that all standing exercises should have as a starting position a correct posture. Caution not to exaggerate. A good standing posture is one in which the body weight is so balanced that no undue strain is placed on any muscle group or pelvic ligaments; the important pivotal points of the body, the ankle, knee, hip, are practically in a straight line, with the body weight transferred largely forward on the forepart of the foot; the chest is held high, the abdominal contour almost flat; the physiologic spinal curves slightly dorso-convexed and lumbar-concaved; the pelvis inclined forward about 60° from the horizontal. In such an attitude the gluteal prominence and the dorsoconvexity are in the same perpendicular which line falls approximately two inches back of the heel. To maintain this attitude it is necessary to have a normal skeleton and a healthy and well-trained neuromuscular system. Conditions which influence this posture abnormally are: (a) a change in the bony architecture (b) weak, atrophied or stretched muscles and ligaments (c) disturbance of part of the nervous system. It is further influenced by incorrect shoes and bad-fitting corsets.

Treatment consists in:

(a) Removal of the cause i. e., bony defects, poor shoes or corsets, conditions maintaining poor posture.

(b) Strengthening of musculature.

(c) Training a proper balance sense. For this purpose we employ general massage, exercise and hydrotherapy. The patient is given a treatment in exercise and posture which is followed by any of the tonic hydriatic procedures. Preferably we use the *Scotch* jet douche because of its powerful tonic effects on the *whole* body. Massage may follow in selected cases.

Exercise. Active exercises only should be employed. Generally speaking the patient should be encouraged to engage in all of the common out-of-door games. Indoor exercises should aim especially towards developing the scapulæ retractors, the stretching of soft contractures of the anterior shoulder girdle, the strengthening of the abdominal group, to hold the chest high and learn correct breathing. If apparatus is available, a good part of the work should consist of stretching and hanging exercises, also balancing exercises of various types. The day's order should, of course, include abdominal exercises, examples of which are described elsewhere. For chest, back and general development, the following may serve as a guide.

(*a*) *Arms, chest and back exercises.*

21. Arms extended sideward. Touch shoulders with finger tips, extend the arms forcibly side and upwards, always behind the body line.

22. Elbows sideward, shoulder high, thumbs touching chest, palms down. Fling arms forcibly backward with palms facing upwards.

23. Arms extended sideward. Lower, cross in front, continue to full extension over head. Reverse direction. Keep hips back and weight well on ball of feet.

24. Arms extended sideward. Make circle two feet diameter, reverse. Emphasize backward motion and keep arms behind body line.

25. Grasp hands behind body. Raise the stretched arms backward and upward with head bending backward.

(*b*) *Leg exercises, standing position. Leg and arm exercises should alternate with trunk movements.*

26. Hands on hips. Alternately raise extended leg forward, sideward and backward.

27. Bring left heel towards right hip. Reverse.

28. See flat foot exercises.

29. Hands on hips. Deep knee bending with knees directed outward and heels raised; trunk erect.

30. Alternate toe and heel raising.

31. Standing on one foot perform various movements with the other.

(*c*) *Trunk exercises, standing position.*

32. Trunk bending with back held straight, hands on hips, then on neck, elbows back, then extended over head.

33. Same as 32 trunk bending sideward.

34. Hands on hips, trunk circumduction.

35. Hands extended sideward, feet together, twist trunk right and left as far as possible without moving feet.

36. Hands on hips, twist hips to the right, the head to the left as far as possible. Alternate.

37. Trunk bending forward touching floor with finger tips.

(*d*) *Abdominal exercises, see Exercise* 1.

(*e*) *Breathing exercises.* Breathing exercises produce certain definite physiologic effects upon the body. They may be practiced in almost any position and during any part of the wakeful period and without preliminary preparations. They are therefore of great value to us in cases of bedridden patients.

Primarily we use deep breathing as a means for strengthening the respiratory muscles, thus helping to keep the chest up and improving faulty posture. It promotes a more complete aeration of the lungs by putting into action certain portions of lung tissue which would otherwise remain more or less quiescent. It very definitely aids the return venous circulation by its suction action on the large veins. Deep breathing exercises promote a greater mobility of the chest wall. We recognize two distinct types of breathing, the thoracic or costal and the abdominal or diaphragmatic; the former is practiced almost to the exclusion of the latter wherever the waist line is constricted, either by corset or belt. It seems best, however, that both be developed and used.

There are three kinds of deep breathing; voluntary, against resistance and forced breathing. The first form is self-explanatory. The second type may be produced by blowing through a thin tube, into a respirometer, musical instruments, etc. This form is particularly useful in the treatment of asthma, emphysema, and postoperative contractures or scars. Forced breathing is the result of running, jumping and other forms of violent exercise.

Although deep breathing may be practiced in any position, the lying supine and standing positions are best suited because of a greater freedom of restriction than is the case in sitting position.

Examples of breathing exercises:

38. May be practiced in combination with arm, leg or trunk movements, but more particularly with first named type.

39. In bed with arm raising, later against resistance.

40. While walking. Ten or twenty deep breaths several times each day.

41. Standing with hands against abdomen and inhale deeply; exhale forcibly by drawing in abdominal wall.

42. Same position as 40 but using thorax only.

43. Arms forward upward raising with heels raising and deep inhalation. Stretch as high as possible. Lower arms and exhale slowly.

44. Same as 42 except exhale with rapid chest slapping from above downward.

Special Exercises for Strengthening the Heart.—The value of selective bodily exercise and certain kinds of baths in the treatment of dilatation and other functional disturbances of the heart has long ago been established. Very serious organic changes in the heart and vascular system are not suitable for physical treatment.

Muscular exercise was first prescribed for "symptoms of breathlessness and debility of the heart" by Sir Wm. Stokes as early as 1854. Since then it has had its advocates among the medical profession to this day. As a result, a number of systems were evolved all based on the same type of exercise, viz., mild effort and endurance, but the methods differed somewhat. Today there are two systems practiced, the Oertel system of graduated hill climbing and the brothers Schott system of graduated resistive exercises. Only the latter is practiced in America, and then almost always in connection with effervescent baths. The plan has had the endorsement of some of the most prominent physicians of England and America. In this list we find the names of Sir Brunton, Sir Broadbent, Sir Stewart, Satterthwaite and others of England, and Anders, Babcock, Billings, Osler, Osborne, Tyson and Ellsworth Smith of America. In the first stages of functional disturbance Dock of St. Louis prescribes mild tonic hydriatic procedures and general massage. He reports marked success in cases of auricular fibrillation.

Dr. Theodore Schott defines the essential characteristics of the plan as given below. For details the reader is referred to his book.

Summary of important regulations governing the passive resistance exercises.

"1. Passive resistance-movements include abducation, adduction, flexion, extension and rotation in a vertical, horizontal or lateral direction.

"2. These movements should so alternate that new groups of muscles are continuously made to act in sequence thus avoiding fatigue.

"3. The resistance should be made by the operator as slowly and gently as possible, but with as much firmness and muscular power as the patient's physical condition will warrant.

"4. The operator should never grasp the patient's limb tightly, but should oppose its movements by firm counterpressure against the advancing side, thus retarding the movement, but always permitting the patient to retain the 'balance of power.'

"5. The operator should change his resistance whenever the direction of the physical force is changed.

"6. To gain a well-balanced and uniform effect these exercises should always be bilateral.

"7. The operator should closely watch the patient's breathing and circulation and at the slightest sign of embarrassment should stop the exercises. The patient should never be allowed to hold his breath while exercising.

"8. A pause of one or two minutes should be allowed between each exercise in order to avoid any fatigue. The patient may sit down during the pause, especially during the latter half of the séance.

"9. The length of time devoted to each séance should be about a half-hour. At the end of that period it will frequently be found that the number of heart beats has been reduced from 10 to 15 per minute and that the area of cardiac dullness has been made to contract an inch, more or less.

"10. After the séance is finished the patient should rest quietly on a couch for at least 15 minutes."

The following series of exercise constitute what is known as group one. Additions of the same type of exercises are made until the number reaches fifteen in group four.

1. Raise the arms slowly outward from the side until on a level with the shoulder. After a pause slowly lower to position.
2. Extend one leg as far as possible sideways from the body, the patient steadying himself by holding on to a chair. Same with the other leg.
3. Extend arms in front of body to a level with shoulders, and then put down.
4. One leg is raised with the knee straight forward as far as possible, then brought back. Repeat with the other leg.
5. With fists supinated, the arms are extended outward and next inward at the level of the shoulders.
6. Raise each knee as far as possible to the body and then extend leg.
7. With fists pronated extend arms as in Exercise 5.
8. Each leg is bent backward from the knees and then straightened.

Hernia.—The best security against hernia is a well-developed muscular abdominal wall. By its contractions it aids powerfully in keeping the abdominal contents in their proper place. A weakness of this defensive wall plus sudden or continuous strain produces an increased intraabdominal pressure which may result in an adbominal hernia. In cases of muscular atony following lessened activity, especially with localized deposits of fat; or women with general muscular weakness induced by prolonged illness, prophylactic measures of massage or exercise may well be instituted. Or, if acquired, these same measures will, with the wearing of a truss, in selected cases, bring about complete recovery. Furthermore, following operative procedure, these measures can help much to hasten recovery and prevent a recurrence.

In dealing with an abdominal recti diastasis, the aim should be towards improving the two recti muscles. Massage and simple leg raising with patient in supine position, will accomplish this. The exercise is to be done 15 to 20 times three times daily, with exhalation during contraction.

In acquired inguinal hernia the desideratum is to strengthen the two abdominal oblique and transversalis muscles. Also, as McKenzie puts it, "To cultivate alertness, control, and self-consciousness in these muscles, thus causing them to respond instantly and automatically to any sudden strain that may be thrown upon them." This, he says can best be done by exercise of twisting and bending of the trunk and by forced breathing, raising the chest high, thus drawing up the abdominal contents and relieving downward pressure. "In the movements of straight flexion of the trunk the rectus muscle only is employed at the beginning and the relaxed oblique muscles are distended, forming two distinct pouches or weakened areas over the lower abdomen, and by the time they contract in self-protection the mischief may have been done."

A caution which must be observed is to support the dilated ring with (a) the finger, (b) a proper fitting truss. Also to always avoid sudden and severe strain with holding of breath, and long standing position. With such precautions patients may be allowed almost all kinds of nonviolent games, like tennis, golf, bowling, dancing, swimming and canoeing. Contraindicated are football, the weight events, field competition, and jumping. Bicycling is championed by Lucas Championniere. Working with Dr. Seaver, at Yale, the writer has witnessed his patients performing all the ordinary gymnastic "stunts" which college students like to indulge in with no untoward results. His percentage of cures of acquired hernia by means of exercise and massage was well over the seventy per cent mark.

McKenzie prescribes a more conservative method of gymnastics as follows:

Exercise 1: Patient lying on back. Place one hand across abdomen, the other protecting the ring. Inhale deeply. Exhale by pressing the abdominal wall until voluntary contraction has been acquired, when this movement can be done without placing the hands over the abdomen.

Exercise 2: Patient lying on back, one hand across the abdomen, the other protecting the ring. Inhale and exhale without drawing in the abdomen. In this way, control of the abdominal wall is obtained, while the hernia is protected by placing the fingers over the external ring. In most patients it is possible to teach them in one or two séances how to find the external ring and how to protect it in the various exercises.

Exercise 3: Patient lying on back, right hand behind the neck, the left hand covering the external ring. Raise the head and shoulder, twisting in the opposite direction from the hernia to the right. In this way the oblique muscles of the affected side are put into strong contraction, but if the movement be symmetric, the rectus alone will receive the strain.

Exercise 4: Patient lying on back, external ring protected. Without bending the knees raise body from the lying to the sitting position, with the shoulders twisted so that the shoulder of the affected side is forward.

Exercise 5: Massage, consisting of circular kneading movement, beginning at the external abdominal ring and passing upward and outward to the anterior superior spine.

Flat Feet.—When we recall the physiologic fact that prolonged rest causes muscular weakness and that muscular weakness is the primary cause of flat feet, we find justification in discussing exercise therapy at this time. Flat feet may be caused by paralysis or trauma, but in the great majority of cases it is the result of a disturbance of the soft tissue mechanism of the foot in consequence of a variety of causes tending towards a weakening of the supporting longitudinal arch of the foot. Prominent among these are wasting diseases, especially of an infectious nature; lack of muscular development or lack of exercise; faulty walking or standing; and ill fitting and incorrect shoes.

Many gynecologists are awake to the debilitating effect of the puerperium on the general musculature. What is true of the puerperium is equally true of typhoid fever and other conditions which compel patients to a long siege of muscular inactivity. A good surgeon will look further than the immediate repair of an injury, and will consider the future welfare of his patient. The modern obstetrician, for instance, considers the future of his patient with reference to bodily outline and poise as well as health, and begins muscle training for feet and posture at the earliest possible date following confinement. Grossman and Gellhorn have pointed this out with special reference to the feet. Therefore, in the after-treatment of patients long bedridden, it would seem wise to institute simple measures which would tend to save the patient future suffering. Exercise and proper massage, particularly kneading and friction of the feet are indicated.

The problems associated with the question of flat feet are many and find discussion elsewhere in this volume. The treatment in all cases, however, aims at the restoration of the architecture of the foot and the muscles and ligaments holding it in position. In so far as the latter is concerned, physical therapy may play a most important part in the treatment.

All cases should first be thoroughly heated to promote the circulation and make the massage, which is to follow, more effective. This heating may be done by means of the hot foot bath (100° to 105°) for 15 minutes, or by a gas or electric light heated apparatus.

The peronei spasm and pain may be relieved by the above mentioned heating process or by hot fomentations applied twice a day. The foot should next be forcibly adducted, inverted and dorsoflexed which may be done by the operator or by the patient himself using his knees as a fulcrum. Massage, particularly kneading and percussion, will frequently relieve spasm; when this method fails, however, forcible stretching under an anesthetic must be resorted to.

The circulation will be improved by the preliminary heating and massage and may be further enhanced by the Scotch douche applied twice daily. Hot, 105° to 110°, for two minutes; cold for one-half minute.

Exercise.—Passive movements should only be used to secure free mobility and should involve all possible motions of a normal joint.

Resistive exercises may be done in all directions save eversion and abduction, which is true also of active movements. We see no valid reason why these should ever be used at all. It is nevertheless frequently prescribed in the exercise of complete circumduction. Eversion and abduction tend to aggravate the condition of fallen arch and also bring into strong contraction the powerful peroneus, a muscle which is generally found spastic and overworked in these foot affections. We must guard against the tendency of overdevelopment of this muscle as compared with its antagonistic group, the adductors. We are also of the opinion, which is shared by others, that excessive heel raising, particularly in the more advanced type of flat foot is harmful because of the additional strain which this exercise places on the already stretched plantar ligament. It will also, in the standing position, bring into powerful contraction the peroneus longus which we believe not to be desirable.

We use the following series of exercise in the Mechano Therapy Department of the Washington University Medical School.

1. Resistive movements in direction of adduction, inversion and toe reflexion.

2. Standing position with feet crossed close together and parallel with each other. Exercise, alternately raise right, then left foot off floor one inch and hold this position for one minute. Each foot five times.

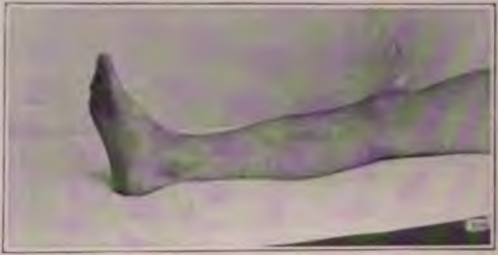

Fig. 179.—Illustrating flat foot exercise No. 3. Starting position. Dorsoflexion.

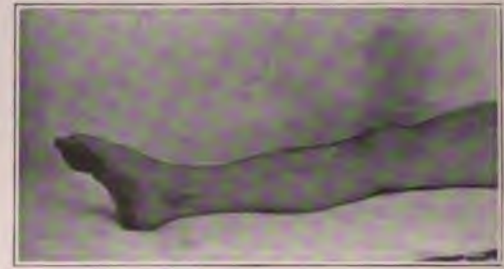

Fig. 180.—Second position exercise No. 3. Complete extension avoiding abduction of foot.

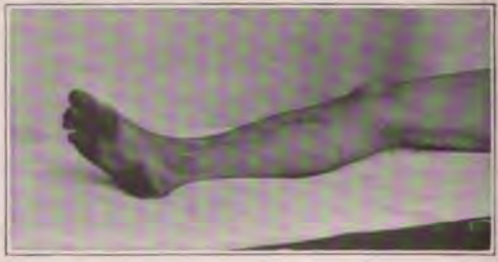

Fig. 181.—Extreme inversion, then bringing foot back to starting position (Fig. 179), retaining during the movement inversion of foot and flexion of toes.

3. Sitting on chair with knees crossed or legs extended place foot in (a) extreme dorsoflexion, using this as a starting position;

(b) foot extension with strong effort at toe flexion; (c) return to starting position (a) with extreme inversion of foot. (Figs. 179, 180 and 181.)

4. "The forefoot is placed upon the end of a towel, and in adducting, the toes are to grasp the towel, pulling it toward the inside. By repeating these motions a number of times the whole length of the towel is moved under the foot, the knee and heel being at the same time not removed from the spot. In placing weights of increasing size on the outer end of the towel the resistance can be increased to any amount desired. After this exercise has been thoroughly practiced in sitting without weight-bearing it should be taken up in standing."—Bucholz.

5. In selected cases, we add balancing exercises, dancing and games.

These exercises should be practiced until fatigue sets in and repeated two or three times a day.

Joint Disturbances.—*Sprains and Dislocations.*—The part which exercise or massage plays in the treatment of sprains is, in many ways, identical with that of a reduced dislocation. In cases of rupture of the muscular attachments or ligaments about a joint, there follows more or less swelling, pain and limitation of motion. If seen soon after the accident the application of proper pressure bandages will do much to promote the absorption of the existing effusion and also act as a splint to support the injured parts. To further promote this absorption, deep stroking massage in the direction of the venous flow will be found very helpful. This is also true of deep and rapid vibration, either manually or by means of a vibrating machine, if applied directly over the seat of localized swelling. After a time passive and active exercises are indicated, provided the injured soft part can be held in close apposition by a splint bandage. The beneficial effect of massage and exercise will be to reduce the swelling by hastening the venous flow, thus causing a rapid absorption of the effusion and to that extent the prevention of fibrous adhesions.

Motion to an injured joint is contraindicated where separation of the injured parts can not be prevented by bandages, thus necessitating total immobilization. This does not apply, however, to healthy distal joints of the same limb where motion should be encouraged, thus preventing the organization of the hematoma and other exudations into fibrous adhesions. There will also be present muscle spasms with pain, and possibly retraction of muscles together causing joint stiffness. There may come a time when adhesions will have to be broken down and there seems to be a right and a wrong time for doing this. At the beginning the new tissue is rich in new blood vessels which are readily torn by movements, causing more bleeding, more effusion and more adhesions. At this stage passive motion should not be given. Active exercise, however, is indicated to the point of producing pain. This apparent confliction can be explained by the fact that active exercise is under control of the will of the patient while passive motion is not. It is quite unlikely that the patient will carry the motion beyond the point producing pain, and therefore the chance of tearing the newly formed tissue is very small. Passive motion, on the other hand, might be carried beyond this point. We thus have a physiologic index guiding us in the proper dosage of motion in these conditions. Massage above the seat of injury and repeated hot and cold douches should not be neglected.

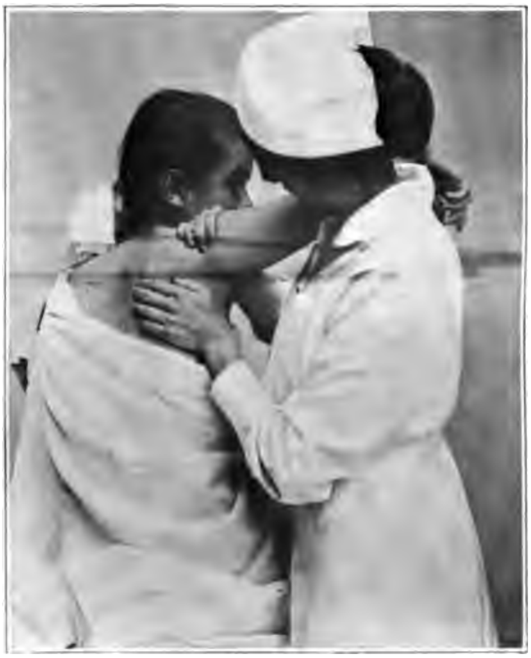

Fig. 182.--Passive stretching of the arm and shoulder with scapular fixation. Breaking adhesions in case of Sub-Deltoid Bursitis.

It is unwise to wait too long before prescribing motion. Prolonged immobilization causes the cicatrix to become firm and stiff, so much so that very frequently they can only be broken under a general anesthesia. If this should become necessary, then massage and active exercise should be encouraged. The exercise should include all possible motions of the joint.

In breaking down adhesions manually we choose the period immediately following the acute stage, when swelling and pain have entirely disappeared. We then employ complete passive motion in all directions daily, preceded by preliminary heating and followed by stimulating massage above and below the seat of injury. If no additional tenderness develops, more motion is applied and deep frictional massage is added to the treatment. (Fig. 182.)

Early Functional Treatment of Fractures.—This method of treating fractures was first practiced by Lucas Championniere of France, and Bennett of England, and has found a large number of adherents. It is founded on the principle that restoration of function is equally desirable with that of bony union and should therefore receive equal attention in the treatment prescribed. It is an unfortunate fact that a very large percentage of fractures, especially near joints, are finally left with badly restricted joint function and pain, almost always due to prolonged immobilization. The surgeon in each case treated the condition entirely from the viewpoint of attaining bony union, leaving the question of function solely to chance. Some one has said that it is far better to have a poor union with a good joint function, than a perfect union with impaired function, and that in a great number of Colles' fractures far greater damage has been done the patient by the treatment than by the injury itself.

In all cases the desideratum should be a good union and fully restored function. Advocates of the early functional treatment believe that by proper splinting and proper manipulations this can be accomplished in a far greater number of cases than without the manipulations. The fact that muscles and joints may be moved without injury to the opposing fragments has long been overlooked by many, and the fact that in delayed union very slight motion of the fragments has proved to be beneficial must also be new to them. Yet this is claimed by many surgeons today.

If a fracture occurs near or into a joint the problems involved are (a) the possible organization of extravasated fluid into fibrous adhesions causing limitation of motion; (b) the passive venous congestion retarding absorption and repair processes; (c) muscle spasm and pain interfering with the aim to hold the fragments in close apposition, besides causing great discomfort to the patient; (d) retraction of muscles leading frequently to contractures. A stiff joint may follow a fracture of the middle third of a long bone as illustrated by a case reported by Bennett. "Fracture of both bones three inches above the ankle two months previous to present observation. Fragments firmly united, good position, no motion beyond a little 'springing' in the ankle joint could be produced. P.M. showed: (a) Ant. Tibialis was firmly adherent to the bone. (b) The muscle structures at posterior aspect of fracture had to be torn and were matted to the bone by cicatricial tissue, involving the Post. Tib. nerve. (c) After each structure had been dissected off the bone the ankle joint could be freshly moved."

Reasons for massage and exercise in fracture treatment are:

(a) Movements of tendons through the area of swelling would prevent matting of these soft tissues.

(b) The increased arterial blood flow would displace the venous congestion, hasten absorption of extravasated fluid and promote repair processes of bone and ligaments.

(c) Exercise would tend to maintain endurance and power of muscles and prevent retraction.

(d) Pain and spasm would be materially reduced by massage aiding thereby bony consolidation and improving the general welfare of the patient.

(e) The joint would be kept supple and retain its *normal mobility*.

(f) Patient's period of incapacitation would be materially reduced. Caution must be exercised in applying this treatment. There can be no question that harm may be done by the improper use of massage and exercise. We must always remember the advantages gained by primary union. We are told that scars, the result of early union, are firmer, less painful and less liable to disease than scars of delayed union. Our treatment, therefore, aims to keep the torn ends of ligaments and tendons together and yet encourage those things which will promote repair processes and retain normal function. Massage and exercise, we believe, are therefore indicated in such cases where adhesive and other bandages and splints will prevent the separation of the torn ends. To illustrate our thought: A sprain of the ankle tearing the external lateral ligament. Apply pressure bandage over seat of swelling and begin stroking massage over injury. Next day, if greater part of swelling has subsided use alternate hot and cold foot baths each four times, to promote circulation. Continue massage above seat of injury and firmly strap foot in eversion. Passive motion to all toes. After three to four days, add flexion and extension of foot. If bandage is properly applied this motion need not interfere with the torn ends. If on the other hand, there exists with this condition a fracture, then the question of motion depends on the possibility of sufficiently supporting the fragments to allow ankle motion. Massage and exercise of toes should, however, be encouraged. (Fig. 183.)

Paralysis.—(*1*) *Anterior Poliomyelitis.*—It is the practically undivided opinion of the men who have studied this disease that absolute rest is essential during the first stage, that is, until all tenderness has disappeared. Massage, exercise or electricity tend only to further irritate the diseased nerve roots. During the second stage these measures constitute the most important phase of the active treatment; the passive are equally important, aiming to prevent deformities by means of braces. The first consideration is to plan all active treatment with a view of getting the patient on his feet as soon as possible, not for one minute, however, losing sight of the fact that the kind and dosage of exercise employed is highly essential. Much harm has been done the patient in the past by overstimulating and overexercising the weak and atrophied muscles. Each individual or group of muscles, if possible, should first be carefully examined and tested as to strength and capacity. Then daily exercise, approaching the active type, should be prescribed. Active because it is essential to develop the neuromuscular system and not merely a muscle. For this reason passive exercise and movements by various types of apparatus are much less effective as a whole, stimulating nutrition of the muscle but not volitional movements. At first it may be necessary to perform the movements passively, but every means should be used to stimulate and encourage the patient to help the movements by concentrating his attention on it. Each movement should be carried out to its

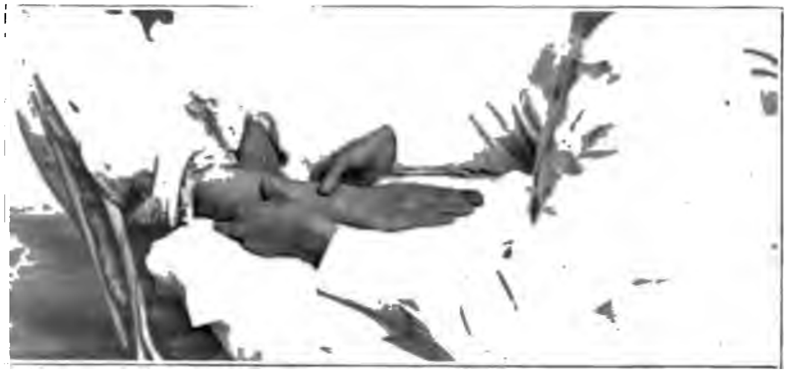

Fig. 183.—Thumb kneading and draining of a Colles' fracture.

physiologic limit. As soon as the patient is able to perform the movement actively or partly so, passive movements should cease, but the active movements must be assisted by the nurse, so as to avoid overtiring the muscle, until the patient can perform the exercise without assistance. As soon as this can be done with ease, then resistance may be offered on the part of the nurse. Great care must be used not to work the muscle beyond the point of mild fatigue. To recapitulate, the aim should be (a) to have the patient perform active exercise, (b) to get it to walk as soon as possible, and (c) to avoid, by all means, overexercising.

The nutrition of the muscle can be greatly benefited by daily mild massage, heating by means of a dry air or electric light heating apparatus and the alternate hot and cold baths to the affected limbs.

Lovett and Martin point out the importance of professional supervision of the exercise treatment. They found "that the chance of improvement in affected but not totally paralyzed muscles under expert treatment by muscle training was about 6:1; under supervised home exercise 3.5:1; under home exercises without supervision 2.8:1. Untreated muscles showed an improvement ratio 1.9:1." We can at this time do no better than refer the reader to the chapter on muscle training by Lovett.

II. Other Forms of Flaccid Paralysis.—The particular indications are as follows:

(a) To maintain and improve the nutrition of the muscle. This is accomplished by means of radiant heat, deep kneading and stroking massage, and tonic hydriatic procedures.

(b) Prevent contractures by means of proper braces, shoes, and daily stretching.

(c) Measures which will stimulate the general nervous system, for which purpose we use the hacking and percussion movements of tapotement and vibration; also the Scotch spinal douche.

(d) Restore the continuity of the impaired motor and sensory paths. This can only be brought about by voluntary exercises which are directed by the will of the patient. Massage, electricity, passive motion or motion caused by a mechanical apparatus can not in our opinion perform this function. In order to achieve the best results, various methods may be employed, which, because of their varying character, tend to stimulate a better cooperation of patient and nurse. This procedure applies of course only to cases of partial paralysis.

1. The patient is induced to imitate the movements of the operator, choosing at first the easier arm or leg movements and advancing to the finer finger or toe movements. This may frequently be done in connection with simple finger plays and games.

2. Exercises following definite commands. Besides their physiologic effect they are of a decided educational value which has a direct bearing on the complete restoration of the neuromuscular complex. They awaken "numerous sensory and motor perceptions, clear cut and well defined regarding distance, direction, weight, force, resistance and effort which might otherwise remain dim and vague."

3. Stimulating initiative by means of various games and plays particularly, if conditions allow it, in company with other children. In a gymnasium class, drills, marching and dancing are excellent. The balance board and wall ladders are very useful apparatus if available. It is a good plan to have both limbs, the sound and paralyzed work together, e.g., with wands, hoops, basket ball, etc., or let the sound limb perform first, the other following. An unlimited fund of patience must be at the command of the operator who conducts the work, for very frequently weeks and weeks go by without any sign of improved function. The patient too gets restless and impatient and his efforts become rather feeble, but, unless the nerve is entirely destroyed, oftentimes repeated voluntary exercises, even if weak, will definitely aid in repairing the damaged motor tract and restoring motion.

III. Spastic Type (*a*).—Here also the essential factor in the plan of treatment is voluntary active exercise, particularly that type involving the element of skill. The plan noted above may well be followed in these cases. In addition there is the problem of spasticity which is present so frequently in a most distressing fashion. The measures which may be tried for the relief of this condition are sedative massage, like slow deep kneading or vibration, either locally by means of a portable apparatus or generally by using the vibratory chair. We have found this latter to be of real comfort in all of our spastic cases. Other useful measures are radiant dry heat, hot fomentations or neutral baths for an hour or more at 95°.

IV. Paralysis Agitans (*b*).—The prognosis is, as much as we know today, almost hopeless. Attention should be directed toward making the patient comfortable. In the line of physical measures we have tried massage, exercise, neutral baths and vibration with varying results. We have found, for instance, that the vibratory chair has given the patient comfort when all other measures failed and we also found that local vibration increased the tremor of another patient to an alarming extent. We have achieved our best results with a sedative massage followed by a neutral douche. The type of massage we use is the slow, deep, long kneading motion centripetally applied, avoiding very carefully any stimulating reaction.

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CHAPTER LII

HYDROTHERAPY

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Water owes its value as a therapeutic agent chiefly to its power to (a) absorb and communicate heat; (b) the facility in which it may be changed from a solid to a liquid to a gaseous state; (c) its property as a solvent agent, and (d) its adaptability to various methods of application.

We speak of the action of cold upon the human body as being a depressant, all the vital functions being lessened in their degree of activity. If, however, this application is a short one, it is followed by a reaction which is tonic or stimulating in nature. The explanation of this phenomenon is found in the fact that the body recognizes cold as a depressing agent and attempts to meet the emergency by quickly producing more heat, the thermic reaction; this manifests itself by causing a rush of blood to the periphery, the circulatory reaction, which in turn is followed by a tingling of the nerves, the nervous reaction. Together they are spoken of as the tonic reaction following an application of cold to the body. If this reaction does not manifest itself in its various phases the cold bath must be modified to a lower degree of intensity or discontinued. There are various agencies which may be employed before the bath which will aid the bringing about of a reaction the most essential being warmth of body. In fact cold should never be applied to the whole body when the skin is cold. This warmth of body may be secured by clothing or covering, hot water, dry heat, exercise, friction, hot drinks or hot enema. During the bath friction and slapping may be employed while following the bath any of the measures used before the bath are indicated.

Cold baths are contraindicated in old age, infancy, extreme exhaustion, either muscular or nervous; in obesity with severe anemia, cold or clammy skin or extreme aversion to cold baths.

A short application of heat is another stimulating agent, but its reaction is atonic in nature. Prolonged heating measures are depressing, leaving the individual in a relaxed, atonic, languid state of feeling. To recapitulate: the application of cold, short, is stimulating, reaction is tonic; heat, short, is stimulating, reaction atonic; cold or heat prolonged are depressing.

In introducing cold tonic baths care must be exercised in beginning with a mild form and graduating to the more severe ones, e. g., (1) cold mitten friction, (2) wet sheet rub, (3) salt glow, (4) shallow bath, (5) cold douche, and (6) Scotch douche (see page 531).

Reflex Effects

Every portion of skin surface is in special reflex relations with some internal organ or vascular area. The vessels may be caused to contract or dilate according as the application is hot or cold, short and intense or long and moderate. As examples may be cited the following, practiced by Abbott, Kellogg, Winternitz and others:

Special Reflex of Prolonged Cold.—1. Cold applied over the trunk of an artery causes contraction of the artery and of its distal branches. Example: ice-bags applied over the carotid arteries decrease the blood going to the brain and head generally. Such an application is called a proximal application.

2. Prolonged immersion of the hands in cold water causes contraction of the vessels of the brain and nasal mucous membrane.

3. Prolonged cold to the upper dorsal region causes contraction of the vessels of the nasal mucous membrane.

4. An ice-bag applied to the precordia slows the heart rate, increases its force, and raises arterial blood pressure.

5. An ice-bag applied over the thyroid gland (in parenchymatous goiter), decreases its vascularity and lessens its glandular activity.

6. An ice-bag to the epigastrium or mid-dorsal region causes contraction of the vessels of the stomach, and lessens gastric secretion while the application continues.

7. Long cold applications to the face, forehead, scalp and back of the neck cause contraction of the blood vessels of the brain.

8. Ice-bags applied to the sides of the neck just below the angle of the jaw contract the blood vessels of the pharynx.

Special Reflex Effect of Short Cold.—Short cold applications to a reflex area produce tonic and stimulating effects in the deep part by virtue of the reaction which soon follows:

1. Short cold applications to the face and head stimulate mental activity.

2. A short cold application to the chest, as a cold rub, friction, or cold douche, at first increase the respiration rate. Soon it results in deeper respiration with a somewhat slowed rate.

3. A cold douche to the precordia or slapping the chest with a cold towel, increases both the heart rate and force. After the cessation of the application, the rate decreases while the force remains increased.

4. Short very cold applications to the abdomen, hands, or feet cause contraction of the muscles of the bladder, bowels and uterus.

5. A short very cold douche to the liver causes dilatation of its vessels, and increase its glandular activity.

6. The reaction from a moderately prolonged cold application to the epigastrium causes increased gastric secretion.

Special Reflex Effects of Hot Applications.—1. A very much prolonged hot application to a reflex area produces passive dilatation of the blood vessels of the related organ.

2. Long hot applications to the precordia and to many other parts increase the heart rate, decrease its force, and lower the blood pressure.

3. Hot, moist applications to the chest facilitate respiration and expectoration.

4. Prolonged hot applications to the abdomen lessen peristalsis.

5. Prolonged hot applications to the pelvis, as a fomentation, pack, or sitz bath, relax the muscles of the bladder, rectum, and uterus, dilate their blood vessels, and increase the menstrual flow.

6. A large hot application to the trunk, as a hot trunk pack in biliary or renal colic, relaxes the muscles of the bile-ducts, gall-bladder, or ureters, and aids in relieving the pain due to spasm of these muscles.

Hydrostatic Effects.—Prolonged application of heat covering a large area causes the peripheral circulation to dilate; if cold is substituted the blood vessels will contract and drive the blood into the internal organs. This interchange of flow is termed depletion and the means of producing it derivation and is used primarily to reduce congestion of areas and organs. While reflex effects are produced through nerve action, depletion is primarily mechanical and although both effects are produced by the same application, one of these will, by its greater intensity, soon overbalance the other. There are definite laws which govern this balance which Abbott defines as follows: "The first relates to the size of the area treated; the second, to the intensity of the application; the third, to the location of the area."

"1. *Size of Area.*—(a) When an application covers a small area, as an ice-bag or a jet douche, the effect is chiefly reflex, and is concentrated upon the internal organ in reflex relation with the surface treated. These applications are so small that the circulatory effect in driving blood from the skin will be slight. The resulting hydrostatic effect, therefore, being very slight and spreading out over all the rest of the body, will be of no importance.

"(b) With all the large applications the mechanical or hydrostatic effect soon overbalances and wipes out the reflex effect. This is true of hot leg-baths, hot packs, full tub baths, etc.

"2. *Intensity of Application.*—When small applications are of great intensity (very cold or very hot or with strong percussion), the tendency is also to produce a decided reflex with but little mechanical effect upon the blood current.

"3. *Location of Area.*—An application made over the heart always produces a reflex effect, no hydrostatic effect being perceptible. The same is true of an application to the head, the reflex effect nearly always being greater than the hydrostatic effect. On the contrary, applications to the feet or legs practically always produce hydrostatic effects unless the applications cover a very small area. This implies that certain areas give reflex effects chiefly, while with certain other areas the mechanical effect predominates."

As illustrative of therapeutic applications may be mentioned:

1. The brain. Blood may be withdrawn from the brain by application of heat to the feet, legs, or the entire lower limbs; also to the spine and entire surface of the trunk.

2. Lungs. It is necessary to use applications to large areas, since the lungs contain much blood when congested. These areas are the feet and legs, and the entire skin surface of the trunk and hips. In pleurisy it is best to use a fomentation directly over the affected area.

3. Pelvic organs. There are two principal areas used: First, the entire skin surface of the hips and lower abdomen, as by a hot sitz bath or hot hip pack. Second, the lower limbs, as by a hot leg-bath. Both areas may be treated by the hot hip and leg pack.

4. Kidneys. Where there is much congestion in the kidneys, it is necessary to use hot applications to the entire surface of the body, the head, of course, being excluded. Less intense congestion may be treated by large fomentations to the back or by the trunk-pack.

5. The middle ear. The whole side of the head and face diverting blood from the internal carotid and internal maxillary. If the hot compress extends below the jaw, the common carotid will be dilated. An ice-bag below the jaw with the fomentation increases the effect by contracting the carotid.

It is possible and frequently advisable to combine reflex with the derivative action. Thus:

To relieve a congested uterus apply ice-bags over lower abdomen which reflexly contracts the blood vessels of the uterus; a hot hip and leg pack drawing blood to the legs. (The pack covers the ice-bag).

Renal congestion. Ice-bags over lower sternum with hot fomentations to loins.

Gastric congestion. Ice-bag over stomach, hot fomentations to dorsal region of back.

Visceral congestion. Hot-water bag to abdomen to divert blood from viscera to cutaneous veins. Cold compress to back which at first causes contraction of the small vessels then dilatation due to reaction.

Technic

1. **Fomentation.**—Fomentation is applied preferably by means of a piece of old blanket about a foot and a half square, which, after being saturated with boiling water, must be thoroughly wrung out by means of a wringer so that every possible drop of water is squeezed out. This is an important element of technic for if any water remains we are liable to scald the patient. Little fear of a burn need be entertained if the part has been well rubbed with an oleate and all the hot water has been carefully squeezed from the piece of blanket. The nurse takes the hot moist piece of blanket, lays it beside the patient, opens the blanket covering, then places the fomentation upon the affected part. It must be quickly adjusted to the part, the blanket closed, and all air excluded by drawing the blanket cover tightly over the fomentation, and especially close at the ends. The patient will likely complain of the intense heat, but must be encouraged to bear it, as this will disappear as soon as the tissues relax. If the heat can not be endured, the nurse may "ease" matters a little by lifting the fomentation from the surface for a few seconds, without greatly loosening the blanket cover, and again dropping it in place. The fomentation may remain in place for five to ten minutes, and may be immediately repeated, or again as soon as the physician deems wise. If it is immediately repeated the parts must be kept covered by the blanket cover, and the process gone through with as little loss of time as possible. Two pieces of blanket will be found useful on such occasions, the nurse preparing the second one while the other is in place being thus enabled to make the exchange with great rapidity, a feature

much to be desired. The beneficial effect of the fomentation can be decidedly enhanced by terminating the treatment with a brief cold application not to exceed a minute. The part is then dried, rubbed briefly with the dry hand and protected from the air.

Effect.—The fomentation is used to relieve pain, produce derivation, as a preparation for cold treatment, and for stimulating or sedative effects, according to the temperature and mode of application. Its first effect is that of a vital stimulant; unless followed by a cold application the reaction is atonic. A brief application is stimulating; prolonged applications are sedative or depressing. For sedative effects the heat should be moderate and the application more prolonged before renewal. These points should be observed in applying fomentations to the spine for insomnia.

2. **Heating Compresses.**—A heating compress is a cold compress so covered that warming up soon occurs. The effect is, therefore, that of a mild application of moist heat.

A heating pack or compress consists of an application to the body of three or four thicknesses of gauze or one of linen or cotton cloth wrung from cold water and so perfectly covered with dry flannel or mackintosh and flannel as to prevent the circulation of air and cause an accumulation of body heat. In case warming does not occur promptly, it should be aided by hot-water bottles or radiant heat. It is usually left in place for several hours between other treatments, or overnight. If left on overnight it should be dry by morning unless an impervious covering, such as a mackintosh or oiled silk, is used. On removal of the compress, the part should be rubbed with cold water.

If the pack dries out before being removed, it will have a mild derivative and sedative effect. If the coverings prevent drying, the result will be that of a stronger derivative because of the local sweating. It also causes relaxation of the muscles and vasodilatation of the vessels in immediate or reflex relation with the surface treated.

3. **Ice Pack.**—An ice pack is used where a large, continuous, and very cold application is desired. Spread cracked ice over a thick Turkish towel, folding one end and the edges over this so as to retain the ice. Apply next to the skin or over a single layer of flannel. This may be used over the heart, also over a consolidated lung area in pneumonia. In the latter case, it should never be applied until after the hot packs have warmed the body sufficiently to prevent chilling. It should occasionally be interrupted by ap-

plying a fomentation. This helps to preserve the desired reflex effect.

Snow may be used in place of the pounded ice. In applying an ice pack to a joint, first wrap the part in flannel so as to prevent actual freezing, then pack the snow or pounded ice closely against the flannel, forming a layer about one inch thick, retaining it in place by a larger flannel cloth wrapped about all and pinned together.

Ice packs should be interrupted often enough to prevent freezing, and either the part rubbed with snow or a fomentation applied to renew local reaction.

4. **Cold Wet Pack.**—*Requisites.*—One or two blankets; a linen or cotton sheet; four small towels and a hot-water bag.

Technic.—The patient in wrapper sits in a convenient chair with feet in the bath of warm water and with a cold compress on the head. The attendant then wrings out the sheet from the water in the bucket and spreads it smoothly over the bed, so as to reach near the foot. The patient then quickly drops all clothing and lies on the wet sheet with arms extended. The attendant, standing on the right side, promptly draws the overhanding left side of the sheet across the body, smoothing it between the lower limbs and along the right side. The arms are then lowered to the sides and the remaining free portion of the sheet is drawn over the body and smoothly adjusted over the lower limbs, covering in both arms. The feet are left uncovered by the sheet, but the hot water bag, covered with a towel is placed at the soles. The underlying blanket is adjusted in a manner similar to the sheet, except that it is not tucked between lower limbs, and the surplus at the feet is folded under them. The blanket should be closely adjusted at the neck so as to exclude all air. Another blanket, folded in several thicknesses, is then placed over the entire body from the neck down and tucked snugly in at the sides. A fresh turban of ice-water is adjusted to be changed every five minutes as it warms.

It is found in many cases that if the wet sheet is allowed to extend beyond the feet and is then placed over the feet without the use of the hot-water bag, the reaction in the feet is slow and correspondingly unsatisfactory. There is no advantage in covering in the feet with the cold wet sheet, and the use of the hot-water bag favors the action of the pack.

5. **The Hot Wet Pack.**—This is applied in three principal ways, viz., by means of a sheet wrung out of hot water; by means of a blanket wrung out of hot water; and by means of both. In many

cases especially in treating children, the first method suffices, and it avoids the necessity of dealing with wet blankets.

Requisites.—These are the same as for the cold wet pack, except that a bucket of hot water should be provided. The bed is protected as previously described and on it two blankets are spread.

Technic: This is practically the same as the cold wet pack.

6. **Hip or Sitz Bath.**—*Requisites.*—Blanket, towels, sitz bath sufficiently filled with water of the desired temperature to cover the patient's hips, a foot bath at a temperature of from 105 to 110° F., except in the very hot sitz bath, when the foot bath should be at least 2 or 3 degrees warmer than the sitz bath, a basin of ice water for compresses for the face and neck if for the hot sitz bath.

Technic.—A blanket is placed about the patient, being pinned at the back of the neck; the patient is seated in the bath, the feet placed in the foot bath. The upper edge of the blanket is brought up around the patient's shoulders and over the edge of the tub, the lower edge covers the foot tub.

A folded towel should be placed at the back and also at the front of the tub under the patient's knees to protect the patient from contact with the tub. Avoid pressure on popliteal space.

Cold Sitz Bath.—Temperature 75° to 55° F., the temperature may be higher when the patient enters the bath and rapidly decreased to the desired degree.

Temperature of the foot bath, 105° to 110° F.

Duration.—One to eight minutes.

Technic.—The patient sits in the tub with the feet in the foot tub, the edges of the blanket are separated and placed over the patient's shoulders; water is dipped from the tub and friction applied to the back, patient giving friction to the abdomen. Friction is applied throughout the bath and may be given with the wet hand or with bath mitts.

Effects.—A short cold sitz bath of 1 to 4 minutes' duration, greatly stimulates the pelvic circulation and tones up the musculature of the bowels, bladder, and uterus. The lower the temperature, and the more vigorous the friction, the more intensified are the effects.

Indications.—Constipation, subinvolution, atony of the bladder. Cold sitz baths may be used to stimulate the liver by increasing the portal circulation. Modified temperatures may be used in treating children for nocturnal enuresis.

Contraindications. Acute inflammation of the pelvic or abdominal viscera, acute pulmonary congestion, and painful affections of the bladder and genital organs.

Prolonged Cold Sitz Bath.—*Temperature.*—85 to 75° F. May be begun at a higher temperature and decreased.

Duration.—Fifteen to forty minutes. No friction is applied. If there is a chilling sensation, a fomentation may be applied to the spine.

Effects.—The pelvic vessels and walls of the uterus become extremely contracted.

7. **Salt Glow.**—Prepare about two pounds of coarse salt and wet with cold water. The treatment should be given in a "wet room" or in a bath-tub. The patient stands in a tub of hot water. While standing at the side of the patient begin with the arm. Wet the entire skin surface of the shoulder, arm, and hand with hot water from the foot tub. This is done by dipping the water with the hands. Next apply the wet salt, spreading it evenly over the skin; now with one hand on each side of the arm, rub vigorously with to-and-fro movements, until the skin is in a glow. Stepping behind the patient to the opposite side, proceed in the same manner with the other arm.

Retain the last position to treat the front and back of the trunk. With one hand in front and one behind, wet the skin surface with hot water from the foot tub. Now spread the salt as before, and rub the entire skin surface of the chest, abdomen, shoulders, back, and buttocks. Stepping behind the patient, with one hand under each arm, continue rubbing with the salt, treating the sides of the chest, abdomen and hips. Next proceed with the legs in like manner. For each limb have the patient put one foot on a low stool so as to bring the thigh about horizontal. Wet with water as before and rub the thigh, leg, and foot with the wet salt. Finish the treatment by thoroughly washing off the salt and dry the patient.

If for any reason the patient ought not to stand so long, he may be seated on a low stool while the salt glow is given.

Proceed as follows: The patient sits on a stool with the feet in hot water. Beginning with the feet and legs, apply the water and then the salt, rubbing briskly with short strokes, the hands being on either side of the part treated. Next treat each arm separately; then the chest, abdomen, and back should be rubbed with the wet salt, the attendant standing at the side of the patient with one hand rubbing the chest and the other rubbing the back. The patient should stand while the buttocks and thighs are treated. Wash off the salt and dry.

The salt glow is a vigorous circulatory stimulant. Since no great amount of cold water is applied to the body, it does not require as great reactive ability as the wet sheet rub or cold douche.

8. **Nauheim Baths.**—The Nauheim bath, also known as the Schott, carbonic acid, carbonic dioxide or effervescing bath, was originally administered in Bad-Nauheim near Frankfort, Germany, from their natural springs. In the last decade or so, however, the bath has been prepared artificially in this country by adding the most important constituents of the true Nauheim water to the ordinary full bath. There are three methods in general usage, which are employed in this country at the present time, differing, however, one from another only in the manner of producing the carbon dioxide.

The chemicals necessary are sodium chloride, calcium chloride, hydrochloric acid and sodium bicarbonate. The hydrochloric acid may be replaced by acid sodium sulphate.

Essentials.—Full bath at the proper temperature (98° to 90° F.), sheet to cover tub, air cushion, large turkish sheet, towels, cold turban, required chemicals, bath thermometer.

Technic.—The patient should rest one hour before the bath, then have his blood pressure, pulse, respiration recorded. When ready he should be assisted into the bath in order to avoid any unnecessary exertion. Inhalation of the carbon dioxide should be avoided by spreading a sheet over the tub and well around the neck of the patient. Watch the patient closely, and should he become cyanosed, unduly excited, pulse weak or irregular, terminate the bath immediately. Help the patient out of the tub, and at once cover him with a warm turkish towelling blanket and put him to bed. Chilling must be avoided, if necessary by aid of hot-water bottles to feet. After an hour's rest again take blood pressure, pulse, and respiration. Baths should not be given more often than five times a week, allowing two days of rest. In very weak cases only every other day. On alternate days it is a wise plan to give the Schott heart movements. A series of baths usually consists of 18-20 or 24 to be repeated after an interval of four to six months.

Indications.—In valvular insufficiency and stenosis, auricular fibrillation, cardiac dilatation and neuroses, Bright's disease, chronic articular rheumatism, gout and obesity, neurasthenia, hysteria, rachitis, anemia, nephritis, chlorosis and locomotor ataxia.

Contraindications.—Acute inflammatory diseases and in acute endocarditis, in extreme arteriosclerosis, aneurysm, and in angina pectoris.

Physiologic Effects.—The physiologic effects are stimulation of the vasomotor apparatus due to the carbonic acid gas and the salts in solution, principally the sodium and calcium chloride. The cutaneous circulation is dilated, drawing the blood from the congested viscera, relieving thereby the labor of the heart. The pulse rate is markedly reduced, but it becomes stronger and fuller. The left ventricle is able to produce a more complete contraction. The blood pressure at first rises from 5 to 10 mm. but invariably drops that much from the starting point. This has been our experience in almost all of our cases complicated by hypertension. The area of dullness in cases of dilatation is often very markedly reduced. Stimulation to the skin increases its activity, thereby lessening the labor of the kidneys.

Methods.—(a) Generating the CO_2 by means of bicarbonate of soda and hydrochloric acid. After the temperature of the water has been properly regulated, the necessary salts, sodium chloride, calcium chloride, and sodium bicarbonate are added. It is well to strain the sodium chloride through a cheese cloth in order to remove the impurities which are usually present. Next add a strong solution of hydrochloric acid equal in quantity to the sodium bicarbonate used, by pouring it directly on the surface of the water from a small mouthed bottle, distributing it well over the entire surface without agitating the water. The layer of CO_2 which forms on the surface, should be dispersed by means of a towel.

(b) The Triton Company of New York (Schieffelin & Co.) has put a very convenient method for the preparation of an artificial Nauheim bath upon the market, which has been used successfully.

(c) By means of an apparatus carbonic acid liquid gas may be used instead of the bicarbonate of soda and HCl. The principle is that of forcing the gas through several pieces of rattan 3 feet long by ½ inch in diameter beveled down from one end to a flat point. The gas is then emitted from the cut ends of tubules or pores along its entire length in the shape of very minute globules which quickly adhere to and cover the skin surface of the patient. By means of a gauge the amount of gas can be absolutely measured and controlled, thus insuring any strength of saturation one may want. When this method is used, sodium chloride, 5 pounds to 40 gallons of water is first dissolved in the water. The amount is gradually increased.

Authorities use various formulas of salts, temperature of water and duration of bath. We append herewith the one we use at the Hydrotherapeutic Department, Barnes Hospital, but wish to add that we do not adhere absolutely to it, changing it as the conditions of the patient may demand. The course of twenty baths extends over a period of four weeks, treatment being given daily except Wednesdays and Sundays.

		NaCl	CaCl	Na Bicarb.	HCl	Duration	Temp.
1st	wk.	4 lbs.	6 oz.	0 oz.	0 oz.	5 to 7 min.	97 to 95 degrees
2nd	"	5 "	8 "	8 "	8 "	8 to 11 "	94 to 92 "
3rd	"	6 "	10 "	10 "	10 "	12 to 13 "	91 to 90 "
4th	"	7 "	12 "	12 "	12 "	14 to 15 "	89 to 88 "

Graduated Tonic Cold Applications

1. **Cold Mitten Friction.**—Cold mitten friction is the mildest general treatment, and can be employed to advantage even in the treatment of feeble, bedridden patients. The water is best applied with a wet bath mitten. One part of the body after another should be rubbed, first with cold water 50° to 75° F., and then with a rough towel. If the circulation is poor, alcohol may be added to the water. The skin of the part treated should become red and warm. The intensity of the local reaction furnishes a guide to the selection of the proper tonic measure. If a good reaction is obtained with the ablution, stronger measures may be used, of which the douches have the greatest range of usefulness.

2. **The Wet Sheet, or Sheet Bath.**—This important measure requires very little apparatus. The best time for its application is late in the afternoon or toward night. The requisites are a pail or large basin of water at 65 F., a foot tub with water at 100° F., ice-water; two face towels; a bath towel; a bed with an extra blanket at hand, and protection for the floor. Put the sheet into the water, letting the corners hang out. The patient, dressed only in one garment, stands in the foot tub containing the warm water. One face towel is then dipped in ice water, wrung out, and wrapped about the head like a turban. The nurse then places a pail of cold water with the sheet behind the patient, and, while standing in front seizes the wet sheet by two corners and throws it around the patient, without any attempt to wring out the sheet. A rough, smart rapid rub applies it everywhere. This process should occupy about two minutes. Then drop the sheet and wrap in the dry blanket, and put the patient to bed. Lower the temperature of the water 1 degree each day until 55° F. be reached.

This is the quickest and simplest method of applying the drip sheet, and may be modified or extended by slapping the surface occasionally with the hand or a wet towel, this increasing the mechanical irritation of the skin. In addition, a basin of water 10° F. colder than the water used for the sheet should be provided, from which water is poured over the head and shoulders two or three times at short intervals, being alternated with slapping and friction for from five to ten minutes. In any given case the physician may judge whether to commence moderately or with the full technic. The general effect is moderately tonic, with the abstraction of considerable heat.

3. **Shallow Bath.**—Prepare bath at temperature of 75° to 65° F., four to six inches deep. Feet should be warm before entering the bath. The pateint sits in the bath and applies friction to the chest, abdomen, arms and legs, the operator applying the same to the back. Cold water is dipped from the tub and dashed over the patient's shoulders and back and friction continued. The patient lies in the tub giving friction to the chest and abdomen while the operator applies friction to the extremities.

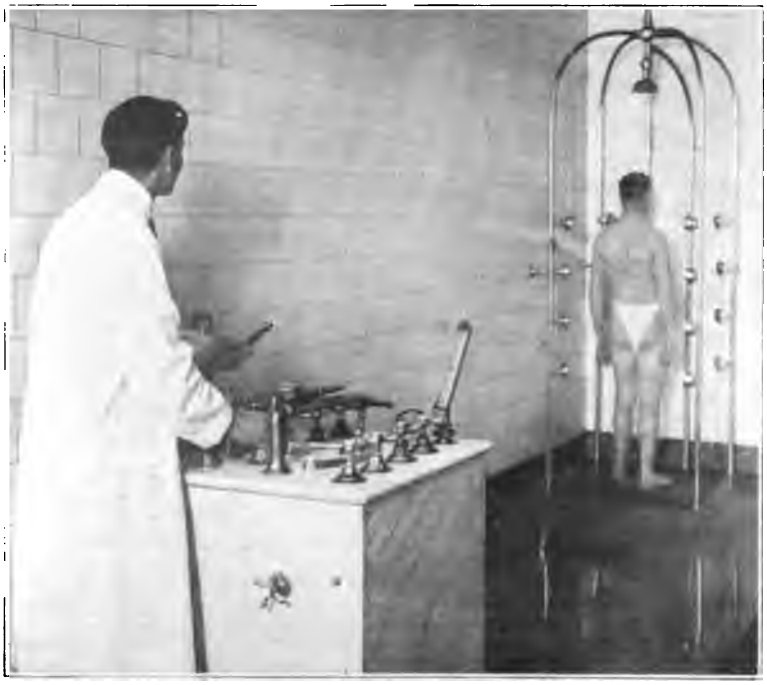

Fig. 184.—Showing apparatus controlling jet douche, needle douche, shower douche, and Scotch douche, and manner of application. Temperature and pressure of water under instant control.

Duration.—Two to four minutes.

4. **Cold Douche.**—This is a single stream of water under pressure coming from a nozzle of ¼ or ½ inch in di [illegible] a distance of

10 to 15 feet from the patient. The temperature may be regulated by valves which govern the mixing chamber in the control table, and may be graduated from a warm stream down to the coldest water supplied. It is a powerful stimulant and useful for its tonic effect after the hot-air bath and circular douche. (Fig. 184.)

It is contraindicated in asthma, as paroxysms of asthmatic breathing may be induced. The sudden contraction of the pulmonary vessels restricts the area of blood subjected to oxidation in the lungs, the carbonic acid is not properly eliminated, and a sense of suffocation ensues. This is corrected as reaction occurs, and the secondary effects are powerful, tissue change being highly stimulated. Fatigue gives place to renewed energy, especially if the cold applications be preceded by heat and followed by vigorous rubbing.

5. **Alternating Hot and Cold Douches.**—This form of douche, for some unknown reason called the Scotch douche, produces distinctly exciting effects. It is not applicable to the head or the anterior chest, but may be applied to the spine and posterior thorax and sides; to the abdomen and to the lower extremities. With temperatures alternating between 105° and 70° F., or possibly a few degrees higher and lower, good results are obtained; in robust patients the extremes may reach 110° and 55° F. or lower.

The Electric Cabinet Bath

Compared with Russian or Turkish baths the electric light cabinet bath offers many advantages. (a) It combines both light and heat. Light is used because of its property of being able to penetrate soft tissue and thus exert a definite influence on the body cells in that way. (b) Because the patient is more definitely under the control of the nurse, which is very important in advanced cardio-renal cases where elimination is so desirable. (c) The heart action is easily controlled by cold applications to the head. (d) The blood can be further diverted from the head by means of a hot foot bath given at the same time. (e) Perspiration can be induced in from five to ten minutes with a temperature of less than 125°. (f) It can be so readily used for the purpose of heating the body preparatory to giving a hydriatic treatment. (g) Can be installed at a relatively small expense in home or institution. (Fig. 185.) The stimulating and tonic effects of radiant light and heat upon the general metabolism are due to several specific actions or effects induced on the tissues in the circulating fluids of the body and are defined by Snow as follows:

"I. The actions on the blood. (1) The oxidizing influences of radiant light and heat favor to a remarkable degree active tissue metabolism. (2) The oxygen-carrying function of the blood is enriched by an increased percentage of hemoglobin due to the direct action of light rays, and (3), the lymphatics are rendered more active in eliminating waste products and toxins by the sweat glands and other emunctories of the body.

"II. The superficial end organs are stimulated to a greater activity with an increased tissue change, both anabolic and catabolic.

"III. The deep spinal centers are reflexly stimulated to greater reflex activity by the intense effects of the applications of radiant light and heat to the peripheral neurons, thereby arousing greater general activity of the vital centers, particularly the perspiratory, cardiac, and excretory centers.

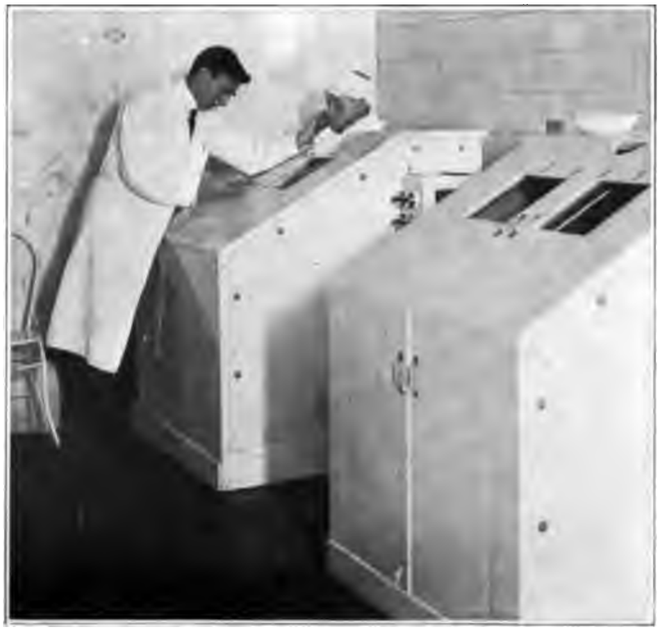

Fig. 185.—Illustrating electric light cabinet bath.

"IV. The general diffusion of heat which takes place by convection from the blood heated at the periphery, promotes general tissue oxidation and elimination throughout the organism.

"V. The actinic and thermic action of the radiant light and heat upon the germs in local areas of infection, causes inhibition of activity and destruction of the germs by the phagocytes thereby relieving the tissues generally from the toxic materials otherw thrown out.

"VI. The induction of superficial hyperemia, local or gener promotes nutrition in the tissues by an increase of nutritio pabulum distributed through the tissues, as well as an increase the number of nature's scavengers, the phagocytes, where h peremia exists, thereby increasing the general tissue resistan as well as awakening a greater metabolic activity.

"VII. The stimulation of increased elimination through the swe glands and other emunctories, induces the removal from the syste of the poisonous toxins which vitiate the general system and cau general impairment of metabolism."

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CHAPTER LIII

POSTOPERATIVE TREATMENT BY RADIUM AND THE ROENTGEN RAYS IN MALIGNANCY

By Russell H. Boggs, Pittsburgh, Pa.

Discussion of the value of radium and the roentgen rays in malignancy necessitates dealing with the various types and stages, and the citation of results produced by each agent alone, as well as when used as a supplementary treatment to surgery. In certain locations and stages of malignancy, anteoperative or preliminary treatment is undoubtedly advisable. In advanced growths in the mouth or throat, and in advanced carcinoma elsewhere, the results obtained both by radium and the roentgen rays, have given them a place as a routine method alone; for instance, in the treatment of selected cases of epithelioma. Postoperative treatment by these agents, therefore, can not be satisfactorily discussed without considering, separately, their positive values when used apart from surgery, and citation of cures by the rays alone will only emphasize their value in treatment of postoperative cases.

Before any one can use radium and the roentgen rays intelligently, it is not only necessary to study the properties of radioactive substances, but also their physiologic actions on both normal and diseased tissues. Interest from the beginning centered around the action which the rays had upon malignant cells; and as a result of detailed studies by many investigators, the treatment of malignancy by radiotherapy has been placed upon a rational basis.

Investigators have shown that the rays given off both by the radium and x-ray tube act primarily on the nuclei of the cells and inhibit their power of proliferation before the function of the cell is impaired. Embryonic cells and those which are undergoing active proliferation are the most susceptible. It has been shown that malignant growths are retarded by radiation and become less malignant, although they may not have diminished in size or disappeared. By further increasing the quantity of radiation, the injury becomes more pronounced, and the cells are completely destroyed, the rays acting differently on the various types of cells, destroying one kind of tissue and leaving the other adjacent tissues intact or so slightly injured that they will completely recover.

The therapeutic action of the rays on a new growth consists, not only in the destruction of the tumor cells, but also in the change produced in the blood vessels. The endothelial cells of the intima degenerate, the lumen of the vessels retract, finally being obliterated, and consequently the tumor cells can not obtain the nourishment needed for their maintenance of life and for their proliferation.

It may be of interest to call attention to some of the reasons better results were not obtained in the early days of radiotherapy, even by those who were good clinicians and pathologists. Radiations from radium are of a complex character as regards penetration, and it is necessary for some of the rays to be absorbed before reaction takes place. Rays of low penetrability are the most active physiologically. Often rays of too low or too high penetration were employed; if too low, only the surface of the lesion is treated while if too high, energy is wasted and the best form of radiation is defeated. Rays given off radium are known as alpha, beta, and gamma. Many did not know, in the early days, whether the gamma or beta ray predominated.

The therapeutic value of radium can not be thoroughly understood if it has not been studied with a sufficiently complete and varied range of filtration. It is also necessary to know how to cut off the low rays, which are not wanted for the lesions under treatment, and to know the method of avoiding the deleterious effects of these rays, as well as to understand the secondary radiations set up by the various filters employed. In the beginning no one was familiar with filtration and secondary radiation. They did not know whether they were treating the patient with beta or gamma rays. Good results were accomplished only after this was known as well as the limitations of radium. Radium, I believe, when properly applied, is the most efficient form of radiation we have, today, for a depth of from two to three centimeters, but large areas can not be treated with it, and when it is necessary to ray the adjacent glands it should be supplemented by the roentgen rays. Modern radiation means the use of radium and the roentgen rays with the improved technic, using the Coolidge x-ray tube.

The treatment of malignancy demands specialized study. Every physician or surgeon who treats malignancy should know its various forms and stages, and also know what has been accomplished by radium, roentgen rays, surgery and any other method by which results have been obtained.

Carcinoma of the Breast.—Treatment of carcinoma of the breast by roentgen rays has been carried out by many during the past 15 or 16 years, and is today a recognized method in the treatment of postoperative cases, recurrent and metastatic, primary inoperable and primary cases which do not permit operation. For a long time it was taught and accepted as indisputable that the only proper and scientific method was the radical operation, which meant the surgical extirpation of the growth even in the hopeless stages; but today it must be recognized that surgery, taught so long as the only method, is really only part of the treatment. Though operation still holds first place in the early cases, even at this stage it should be supplemented by roentgen therapy. This sentiment is spreading among some of the leading surgeons, who in the past did the most radical operations for cancer of the breast at any stage, their advanced views springing mainly from comprehensive experience with a great number of cases traced carefully to their end results. Roentgen therapy is taking the place of the ultra-radical operation, such as removal of the supraclavicular glands, or the clavicle.

It is our duty as roentgenologists to teach the profession the indications for roentgen therapy and that postoperative treatment is just as important as asepsis before and during the operation. While statistics are of little value, it can be safely stated that proper postroentgen treatment will prevent from 25 to 50 per cent of recurrences even in the early cases, because cancer cells can be destroyed at a greater depth and distance from the original growth. If the surgeons can cure 40 per cent of cases in a certain class, why not make it 90 per cent or more? It will be a big task to demonstrate this fact to surgeons, inasmuch as many of their cases will receive inefficient therapy in the hospital by a nonmedical technician, and if results are not obtained, they will relieve themselves of the responsibility by saying the rays were at fault. Then, too, it is feared that too much therapeutic work is undertaken in a halfhearted manner, even by many who can do exceptionally good roentgenographic work. Surgeons long ago agreed that too many unqualified physicians operate. Since they know that proficiency is necessary in operation, they should realize that just as much care and skill is required in giving therapy.

Treatment of carcinoma of the breast by roentgen rays has, comparatively speaking, passed through the same stages as surgery. The early stage might be compared with surgical treatment of a quarter of a century ago when they only amputated the breast. Our technic in the beginning was very crude; we neither used filters nor had a standard dose, and we omitted important chains of lymphatics where metastases frequently occurred. Indeed, it is quite remarkable that a creditable number of good results were obtained when one considers the inefficient equipment and faulty technic employed.

Today many have standardized their dosage and with the Coolidge tube, are able to give uniform treatment, but the amount of radiation which should be given has not been determined in a uniform manner by the roentgenologists. This is, of course, a difficult task, each case being an individual study; nevertheless, it is time more attention be given to the postoperative treatment of carcinoma of the breast, in order to standardize, as far as possible, a technic for the different types and stages of the disease, just as surgeons have standardized operation.

Take a given case; let us decide what amount of radiation should be given immediately after the operation, how extensive it should be, when and how often it should be repeated. All roentgenologists agree that each case should have a full physiologic dose, or all that the skin will stand, not only to the anterior chest wall, but to every chain of lymphatics draining the breast, as well as to the opposite side of the body. The location and stage of the tumor; the kind of operation performed, and the physical condition of the patient must be considered carefully in determining treatment. The writer believes two to three times the usual dose of radiation can be safely given in the supraclavicular region, in places where there is no scar and where the cutaneous circulation has not been interfered with by the operation. A study of the supply of the lymphatics and the manner in which they metastasize should be made by every one treating carcinoma of the breast. This will never be done by the nonmedical technician. In fact, too little attention everywhere has been given to the supply of the lymphatics, their depth and extent, and the best manner of thoroughly radiating each chain. Raying the lymphatics sufficiently to proper depth and coextensive with metastases is indeed no easy task. It requires as much care and judgment as the most careful dissection. Efficient radiation makes operation more radical, increases the percentage of cures in early as well as in more advanced cases, and delays recurrence in all cases.

A visit to our best hospitals shows that a very small percentage of carcinomas operated upon receive proper roentgen treatment. Who is at fault? Both the surgeons and the roentgenologists. Many surgeons refer for postradiation only cases which are really considered inoperable and then often not until a recurrence has taken place. Still they would like to make the operation more radical.

Do they not know that this can be accomplished by the roentgen rays? Many cases have been treated as a placebo, rather than a real effort to effect a cure. Often these patients would be given a few treatments within a week or ten days after the operation with no further radiation. This was called postradiation, and from this slipshod method the physicians and surgeons drew their conclusions as to the value of the roentgen rays. Had they taken no more pains with the operation, surgery would long ago have been abandoned.

If we as roentgenologists are going to treat cancer of the breast, we must be familiar with the different forms and stages, so that our opinion will be worth something in deciding the best method or methods of treatment. We should know whether or not operation is indicated, as well as what can be accomplished with the roentgen rays. We must be consultants, rather than merely technicians as some have been in the past.

It has been pointed out by competent surgeons, when an operation was performed before a diagnosis could be made clinically without a microscope, that 80 per cent of the cases could be cured. Deaver and McFarland in their recent book, "The Breast, Its Anomalies, Its Diseases, and Their Treatment," make the following statement:

"It has been stated that 80 per cent of patients in whom the disease is confined to the breast, as proved by both macroscopic and microscopic examinations of the tissues adjacent to this organ are permanently cured of their disease by the radical operation. Therefore, a patient presenting a small movable mass localized to the breast, can be assured that four out of five cases of a similar nature are cured by operation. When axillary lymph nodes are palpably enlarged as the result of metastases, the chances of operative cure are at once diminished to one in five." The authors further say that; "in the opinion of many surgeons, involvement of the supraclavicular glands is a contraindication against operation."

The absence of palpable enlargement does not always mean an absence of carcinomatous involvement. Halsted found that, notwithstanding the present day extensive operation, death from metastases occurs in 23.4 per cent cases, and even in cases with microscopically negative axilla. A few years ago scarcely any of the physicians or surgeons realized the importance of this; and even today there are some who are operating on late or advanced cases, expecting the same results that the leading authorities obtained in early cases. Retraction of the nipple, axillary and supraclavicular involvement are late symptoms from a prognostic standpoint. Phy sicians who talk about favorable cases for operation when the nippl is retracted, as well as when the axillary and supraclavicular i volvement is present, should read Deaver's book quoted above; i fact, any one treating cancer of the breast, who reads this boo carefully, would not be so radical from a surgical standpoint, an would appreciate more the value of the roentgen rays.

Deaver questions whether as much palliation is received from o erative as from nonoperative methods, and expresses his genera dissatisfaction with operations of a palliative nature in the treat ment of carcinoma of the breast; since, in certain cases the diseas has been excited to greater activity by an incomplete operatio and the life of the patient considerably shortened. In this connec tion he mentions the unreserved statement of Bloodgood, that "in complete operation hastens death." He further states that sinc 1897 such extraordinary advances have been made in roentgen therapy that remove most of the indications for the ultraradical operative procedures, which have practically no curative value, and a primary mortality of at least 25 per cent. Since Deaver's carefully prepared volume is a resumé of the entire medical literature and of world-wide clinics, and since he has included a *valuable* chapter of roentgentherapy of Pfahler's, it deserves more than passing notice.

For my part, I am well convinced, from the cases I have seen during the past fifteen or sixteen years, that an incomplete operation should never be performed, not even for palliation. It is just as necessary that as complete a study of lymphatics of the breast, the frequency and extent of their metastases should be made by the roentgenologist as by the surgeon. The lymphatic supply of the breast is greater than that of almost any organ of the body, so that metastases even of the abdominal organs occur more frequently than is generally realized. In the past many have given a few treatments over the line of incision, axilla and supraclavicular areas. Such treatment is very incomplete, since it omits those lymphatics which frequently metastasize; namely, suprascapular, anterior pectoral of the opposite side, internal mammary, subscapular, paravertebral, xiphoid and inguinal group. A study of bone metastases makes us realize how extensively the lymphatics become involved. It is known that metastases may occur in distant glands at a very early stage of the disease. While the axillary glands are the most frequently involved (indeed so frequently involved that the microscopic freedom at the time of operation is the exceptional) in some cases they are free when there is involvement of the abdominal or other internal viscera. The value of palpable glands is overestimated. The lymphatics in the axilla may become enlarged by previous infections of the arm or breast. Therefore, it requires judgment, and in some cases microscopic examinations, before the cause of enlargement can be positively determined. Metastasis, too, varies with the different types of tumor and occurs earlier in the young and fat patients, owing to the greater richness of the lymphatic supply. Efficient roentgen treatment must take care of these variations.

It is generally conceded that the smaller the caliber of the lymphatics, as well as the greater the degree of senile atrophy, the greater the tendency to oppose cancer dissemination. If the roentgen rays did nothing more to adjacent lymphatics than produce a sclerosis, the treatment would still be indicated for retarding the disease. The frequent involvement of one breast to the other, is due to the distribution of the lymphatics of the chest wall. Autopsy has shown that the liver metastasizes more frequently than any of the internal organs and in many cases becomes involved in comparatively early stages.

According to Handley, the frequent involvement of the liver is attributed to the cancerous dissemination along the deep lymphatics of the fascia of the thoracic wall to the epigastrium and to the umbilicus, whence these cells follow the subserous lymphatics to become deposited either on the surface of the liver, or, are conveyed along the lymphatics of the falciform ligament to the portal glands. If Handley's deductions are correct, we should never omit heavy treatment over the epigastric region. The next in frequency are the lungs and pleura, which are supposed to become involved through the intercostal or supraclavicular lymphatics. A study of autopsies shows that almost any organ of the body may metastasize from cancer of the breast, and however much confined to the superficial tissues this dissemination may seem to be, no one can absolutely foretell how far the so-called "microscopic growing edge" of cancer may extend. Bone metastasis increases with the proximity of the primary growth, the clavicle and distal extremities rarely being involved.

Many consider a three-year limit a cure of cancer of the breast, but we can not be sure recurrence will not take place later. Barker has stated that 30 per cent of the cases that are clinically cured at the end of three years later die of cancer of the breast. Since operation has about reached its limit and since ultraradical operations are not practical until some better form of treatment is discovered, the splendid results achieved from radiation furnish more than sufficient reasons for giving every case of carcinoma of the breast postroentgen treatment. This should be done even if the tumor is only as large as a filbert, because even in such cases, there may be early and fatal metastases. Handley says the pelvic viscera are involved in 8.6 per cent of the early cases in young patients, and in only 4.8 per cent of the late cases of older patients.

While roentgen rays find their most useful field in postoperative therapy, it is difficult to convince either the patient or the average physician or surgeon of this fact, because they can not see that anything has been accomplished. It is the teachers of surgery first of all whom we must convince, because today they have come to realize that the most radical operation, even in the early cases, does not always reach the cancer growing edge.

Many roentgenologists have adopted the following, or its equivalent, as a standard dose, or the amount which each area of the skin will tolerate safely using a Coolidge tube and a modern transformer, tube distance 8 inches, filtering the rays with 4 millimeters of aluminum, with a 9 inch parallel spark gap, 25 milliampere *minutes* are given. With most transformers this dose will *measure 20X* Koenig-Gauss modified Kienbock scale. Most of us would like to give more radical treatment in order to produce better end results, and every one has been looking for some means by which the skin will tolerate larger doses safely. I give larger doses than this over the supraclavicular area as soon as possible, because this is a place often involved, and the surgeon seldom advises opening this chain, because when involved, many have learned it is really inoperable.

Unless the roentgenologist has witnessed the operation, he should always obtain a careful report from the surgeon as to the location of the growth in the breast, as well as the extent of the disease and type of tumor. Then the amount of treatment, as well as the most important regions to treat can be determined. We all know that not only the axilla and opposite side, but also the glands in the pelvis, should receive postradiation if the best results are to be obtained, but this is not always practical; first, because the patients will not consent to such a lengthy course of treatment, and secondly, because the number of square inches that can be radiated is limited when a full dose is given more than once. None are able to tell in the individual cases what chain or chains of lymphatics have metastasized. If the growth is small and situated to the inner edge of the breast, it would probably be more important to ray the opposite breast, opposite axillary, supraclavicular and suprascapular areas, than the axilla of the affected side, on account of the location of the lymphatics which drain the sternal side of the breast. The inner side is rarely involved as compared with the axillary. All ray both the axilla, supraclavicular and suprascapular areas, as well as the anterior chest wall and many ray the opposite side, but as before stated, since the viscera, particularly the liver, mediastinum, lungs and pleura so frequently metastasize, treatment should be directed to these organs as well. This is the least that should receive postroentgen therapy, and is never wide or extensive enough in advanced or recurrent cases. An examination at autopsy of the lymphatics which metastasize will convince one of this fact.

What we are looking for, therefore, is the best method of raying the widest area with the least effect on the skin, and the least loss of radiant energy. I have adopted the following method, and the experience gained from treatment of recurrences has made me increase the areas from time to time:

1. In order to prevent recurrence in the wound, and destroy any foci in lymphatics of the anterior chest wall leading up to the inner clavicular area, three to four areas of anterior chest wall receive treatment, the last being directed downwards towards the liver. Then the liver area is given one anteriorly, one laterally and one posteriorly. With this amount of treatment, the scar is nearly all removed and a recurrence in the area is rare in comparison with the number of recurrences in cases not treated by radiation.

2. The axilla receives from three to four doses and is cross-fired as much as possible. One area below the axilla can be covered by one treatment laterally. The supraclavicular glands are usually involved from the axillary.

3. The supraclavicular region is divided into four areas: one directed obliquely inwards including the lower cervical glands, one downward through the shoulder area towards the axilla, one obliquely downward and backward through the clavicle, and one obliquely forward from the posterior surface.

4. The suprascapular area much more frequently metastasizes than the subscapular. Each should receive a full dose on the affected side, while on the opposite side the subscapular area might be omitted in early cases.

5. The mediastinum should receive one or two treatments from the posterior to an area between the spine and scapula of the opposite side directed towards the affected breast region.

the pain and offensive discharge disappear, the patient's gen health improves rapidly. This even occurs in some patients are in a toxic condition and have been taking morphine; the is relieved and no medication is necessary. In some cases an crease in weight is observed and the patients are restored to fect health.

Many observers have agreed that the carcinoma in these ho less cases disappears locally, and the patient is locally or clinic cured in from one-fourth to one-third of the cases, but when th are extensive metastases, the treatment is only palliative. In m of these cases hepatic metastases have taken place before they w referred for treatment. Often deep metastases can not be determi by physical signs. Nevertheless, the palliation is more satisfact and possibly adds from four to six times to the life of the pati as compared to any other palliative measure, and even hope cases have remained well more than three years; but space does permit giving any statistics.

In conversation, one of the leading gynecologists of the coun said that a vast majority of the cases of carcinoma of the cer that consulted him were inoperable, and then he considered eith removal or cautery only as a palliative measure, and that the pa liation was of very short duration in most cases. He furth stated that he had seen cases of the same class, where radium w applied either as an adjunct or alone, and that the local disease h entirely disappeared in some instances, and that a few remain free from symptoms from one to three years.

Frank, in an article published in the *Journal of Cancer Resear* January, 1917, advises "that all operable cases be subjected to short preliminary treatment by radium, followed by an abdomi hysterectomy." This preliminary treatment, he states, should vigorous and of short duration, with the object of sterilizing growth, and the operation should be undertaken before paramet scar formation takes place or has advanced too far. If it is far advanced the pelvic connective tissues in the cases operat upon are found to be so hard, contracted and board-like that t ureters could not be identified or pushed away from the uteri arteries. In view of his observation, Frank deemed it best not operate until the lapse of three weeks because the growth wou not be sufficiently cleansed from a bacteriologic point of vie Four weeks after the operation radium should be resumed.

I have never treated an early case of cancer of the uterus b fore operation and merely mention this because Frank speaks sterilizing the growth by heavy radiation. Another point which is worthy of consideration is that Frank advises operation between two or three weeks after the radiation and not five or six weeks when a large amount of connective tissue has formed. The time for operation is important in the borderline cases if anteoperative radiation is given. The time for operation after anteoperative treatment is not only determined by the time, but also by the amount of radiation.

Postoperative treatment of uterine carcinoma is an important field for radium, supplemented by the roentgen rays from without, but it is usually neglected until there is a recurrence. Of course, it is difficult to estimate the exact benefit to be derived from postradiation, but many believe they increase the number of cures by this method in carcinoma of the cervix. It is only a question of a short time, until gynecologists will advise postoperative radiation, the same as is done by most surgeons after operation for carcinoma of the breast. Many of those employing radium are depending on radium alone, and are not supplementing it by the roentgen rays.

Experience of the past three years has shown that we can not treat successfully with radium at a greater distance than two or maximum three centimeters. It has been universally accepted that cancerous growths can be promptly and also apparently permanently cured at this depth from the radium tube. However, if the disease is advanced and there is infiltration of the growth into adjacent lymphatics, the cure is only apparent. The local growth may disappear, but if metastasis takes place before treatment is given, it will progress, if radiation is effective only for two to three centimeters from the tube, without regard to the quantity of radium applied or to the length of time it is applied. Larger quantities of radium have been tried and the time of exposure increased so as to influence cancerous cells at a greater depth, but the universal reports show that not much success has been accomplished in this direction. The overlying tissues were damaged beyond recovery, regardless of the kind of filters employed. The rays of radium in contact with the growth were too intense where it entered, and too weak at a greater distance from the tubes than two or three centimeters. Placing the radium at a distance from the surface so the rays would be nearly uniform at the point of entrance and at the distance required, renders the radiation too weak even if large amounts are employed. The tion is not held to apply to the present roentgen erfully excited, gives off many thousand times more rays than any quantity of radi any one has ever used. It has been estimated that with 92 gr of radium it would be necessary to place the radium at the sa distance in order to obtain at a depth of 10 centimeters, the sa intensity of radiation as with the roentgen tube. This does mean that it would be necessary to give the radium in five to minutes as we are doing at the present time with the roent rays.

It has been found that radiation will destroy cancer cells a depth of ten centimeters from the surface of the skin, and intensity is reduced from 100 to 15, that is about one-seventh of t on the surface.

In order to show the manner in which gynecologists are taking the treatment of radium in uterine cancer, the following is quo from John G. Clark's paper, "What Do the Newer Methods of Tr ment Offer the Patient with Malignant Disease of the Uteru (New York Med. Jour.).

"Basing our statement upon the literature, and upon our o limited experience in the use of radium, we should set down definite postulates the following conclusions: (1) Up to the prese there is not sufficient evidence in favor of radium to justify o in using it as a substitute for surgical measures in operable cas (2) As a forerunner to, and a follower up of an operation, it unquestionably advisable. (3) In operable cases it should variably be tried, for apparent cures have occurred in some marke advanced cases, and in those cases that are ultimately cured, th is nevertheless a decided amelioration of symptoms—in many stances, the offensive discharge and hemorrhage completely appear. (4) A serious disadvantage in the use of radium is t it occasionally produces a widespread necrosis, leaving vesical a rectal fistulæ in the wake of its destructive action. This, howev usually occurs only in advanced cases of carcinoma, and need n therefore, deter us from the use of the remedy."

Local injury to the patient will seldom occur, it seems, if t proper amount and kind of filtration is used and if the dosage adapted to the individual patient. We know that tissue will sta large doses of radium, if not too often repeated, leaving no sc or adhesions. Radiation carried to the extent of severe injury normal tissue may defeat its own ends. The tissues can be mo severely inflamed and yet make a complete recovery by radium soon than by any form of roentgen therapy.

Clark's remarks could be applied to carcinoma of the rectum, bladder, and prostate. Operate on every operable case, radiate all cases after operation. Some surgeons advise against operating on borderline cases because usually they can be clinically cured by radium. All advise radiating advanced cases, for an occasional cure will be obtained, and some can be made operable. Radium supplemented by roentgen therapy in far advanced cases will give great palliation, but a cure will not be effected. Some of these cases are clinically cured in that all visible signs of the disease will disappear, but the patient will later succumb to deep metastases.

The amount of radium element, the screening, the distance from the growth, the time of exposure and the nature of the tissues to be acted upon must be carefully considered when deciding upon the dosage. The law of reaction is the governing factor in its use, and success can only be attained when the radiotherapeutist is familiar with his agent, and knows the exact pathology and extent of the disease. He must also know the limitations of radium, and not promise a cure when nothing but palliation may be expected.

There is a difference of opinion in regard to the technic of applying radium in uterine, rectal, and vesical carcinomata. Kelly, Koenig, and others advise the use of large quantities of radium, while others advocate the use of smaller quantities, applied for a longer period. All have generally agreed that less than 50 milligrams of the element should not be employed in uterine carcinoma, as stimulation of the growth instead of destruction might occur. Pinch, of the London Radium Institute, where large quantities of radium are advisable, prefers to use from 50 to 100 milligrams. Bumm and many others have come to the same conclusion. What final dosage will be decided upon to produce the best results remains to be seen, but in reviewing the literature, it appears that many have decided upon doses from 2000 to 4000 milligram hours, to be given within the first week or ten days. The dosage must always be decided upon for each individual case. Some give this amount at one séance, while others divide it up into six or eight. The results seem to be about the same, but the condition of the patient possibly should determine what course to pursue. If used continually until a full dose is given, it is advisable to remove the radium and give a cleansing douche. The treatment is repeated in three or four weeks, according to the indications.

There is also some difference of opinion in regard to screening, but all agree that at least 2 millimeters of lead or its equivalent of brass or bronze is necessary. The latter is being prepared by many, as it is claimed that bronze gives off less secondary radiation. The metallic tube is covered with sufficient rubber, gauze or other substance to cut off the undesirable secondary radiation. One millimeter of pure rubber, covered by gauze and a finger cot, answers this purpose.

The distance of the radium from the growth is only the thickness of the filter, but this must be taken into consideration when deciding upon the length of exposure, as well as the amount of radium element. During the past year some of those purchasing radium have visited me and they seemed to think all they had to do was to insert the radium. They were unfamiliar with a radium or roentgen reaction on the surface of the skin or mucous membrane, to say nothing of the deeper reaction. They would start in about the same way as a gynecologist would without knowing the principles of aseptic surgery, expecting to learn by sacrificing his patients. Roentgenologists who have had experience in therapy are much better qualified.

I can not too strongly advocate that radium be supplemented by the roentgen rays, feeling sure that smaller quantities applied locally with proper roentgen therapy from without are equal, if not superior, to any quantity of radium ever used up to the present time so far as the end results are concerned. Kelly uses radium at a distance of two to five inches from the surface in large quantities from without, in the same way as many are using roentgen therapy from a Coolidge tube. Whether his results are equal or superior remains to be seen. As light decreases inversely with the square of the distance, the tissue would be rayed more uniformly with the source of energy at 8 or 10 inches than at 2 or 5 inches. Besides, greater areas can be treated. Although the better method of treatment still remains to be determined, most of us who have treated a number of cases of fibroids will expect more from the combination of radium and the roentgen rays than from radium alone, or when treated by any other method. As before stated, this is the method which is carried out in European clinics, and many of us have witnessed their results.

Carcinoma of the Rectum.—Results obtained by the use of radium in carcinoma of the rectum vary greatly, and can not be compared with the results obtained in the treatment of carcinoma of the uterus. If sufficient amount of radium therapy is given, a proctitis generally occurs, which is very troublesome unless a colostomy has been performed. Most of those using radium in the treatment of carcinoma of the rectum advocate colostomy before beginning, or within one week after the first radium treatment. This prevents the feces from aggravating the radium reaction, and avoids the tenesmus which always occurs if a full radium treatment is given. Where colostomy has been performed and larger doses of radium have been employed, a few inoperable cases of carcinoma of the rectum have been apparently or temporarily cured. If the patient will not consent to having a colostomy performed, palliation can often be obtained by the use of radium; that is, the growth will be inhibited or reduced in size, which will temporarily relieve the threatened obstruction. Pain is also relieved, either entirely or partially, but it must be remembered that unless a colostomy is performed, tenesmus might occur if large doses of radium are employed. Of how much value radium is in the treatment of carcinoma of the rectum as a postoperative procedure, other than that which follows colostomy, is difficult to determine.

The symposium on "Cancer of Certain Pelvic Organs," read before the Massachusetts Medical Society, June 9, 1915, from a clinical standpoint, should be studied by every one interested in the treatment of malignancy. This symposium emphasizes the importance of more radical operations than have been heretofore performed for carcinoma of the pelvic organs, or else it suggests the addition of radium and the x-ray or some unknown treatment before it can be said we are able to cure a majority of cases which can be diagnosed clinically. The surgeons who took part in this symposium were not only of the highest rank, but each had specialized and directed his attention to only one of the pelvic organs.

In this symposium Dr. Daniel Fiske gave the statistics of the Harrison-Cripps cases to show how absurd it is to talk about carcinoma of the rectum as a benign condition. The statistics are as follows: He saw 445 patients and operated upon 107; of these 107 cases, 17 per cent died from the effects of the operation, and 40 were alive five years after the operation; that is, 9 per cent of the total number seen. It would be fair to assume that not more than 5 per cent would be alive at the end of ten years.

In this symposium Dr. Arthur L. Chute states: "The story of carcinoma of the bladder is most discouraging when we consider the small number of cures that we effect by means of operation. Just enough cases remain well after operation to allow us to say that cancer of the bladder is not absolutely hopeless and to spur us to renewed effort in the hope that when we have a clearer understanding of the condition, our results will be better."

If it were possible to make an early diagnosis when only the mucous layer of the bladder is involved it would seem possible that such conditions could be promptly healed by radium. A few good results have been reported, but unfortunately these cases are usually diagnosed late, and it is more difficult to apply radium to the bladder than to almost any other organ in the body. The danger of setting up an obstinate cystitis is always to be remembered. From studying the lymphatic supply of the pelvic organs, it is readily seen how difficult, if not impossible, it is to remove the adjacent glands involved at the time of operation, no difference how radically it is performed. It is usually impossible to remove all the glands affected. The question, when operating, is if the glands are affected where are we going to stop?

Young, in discussing the uses of radium in the treatment of cancer of the prostate and bladder, states that, while it is not his intention to speak of the ultimate results, it can safely be stated that truly astonishing results have been obtained in some cases; namely, disappearance of obstruction, shrinkage and great softening of certain cancers of the prostate, and extensive retrogressive changes in inoperable cancers of the bladder. The methods devised by Young offer a new fertile field of therapeutics in a class of urologic cases which heretofore have been almost beyond relief. While we do not as yet know all the possibilities of cure, we do know that much relief can be afforded.

Epithelioma.—The term "epithelioma" is not altogether clear in the minds of the profession. It is unsatisfactory and is applied to all epithelial growths, semi-malignant or malignant, regardless of the degree or situation. This has accounted for a diversified opinion in regard to many innocent looking lesions which in time will show a malignant and destructive character. Education alone will teach the value of early recognition when the treatment is easy by one application of radium. Many patients with lesions of this type come late after they have been treated by superficial caustics and are in a hopeless condition. It is to be remembered that true epithelioma has certain pathologic characteristics. It is a purposeless proliferation of cells, extending beyond normal limits and invading adjacent tissues, especially the lymphatics, with slight inflammatory changes. Most textbooks have classified epithelioma under three varieties,—superficial, deep and papillary, but it means nothing to the average student and he leaves college with a vague idea of epithelioma, except complete excision, and does not recognize the early lesions.

It is astonishing how common epithelioma is and how many cases are seen in the large clinics who have never consulted a physician and the disease is so far advanced that they are incurable. Epithelioma, at least in the early stages, does not seem to cause any alarm among the inhabitants of a community or even among the family physicians. The disease comes on so slowly that often no one takes any notice of it until the lesion is far advanced. After the age of thirty-five, all persistent lesions which are constantly inflamed and scaly or show any degenerative changes should receive attention. The prophylactic treatment is by far the most important and necessitates not only the education of the medical profession but also of the laity of the necessity of the complete removal of all excrescences, such as warts or degenerated moles; the removal or correction of any irritation to the skin or mucous membrane; the proper treatment of cracked lip, persistent spots of eczema and leucoplakia. Precancerous changes should receive more attention by the physician. He should hold himself responsible for any of his patients becoming incurable, especially if the epithelioma has been of long duration.

Present day results in the treatment of epithelioma are much more effective than in the early days of radiotherapy. In the past, whether using radium or the roentgen rays in the treatment of epithelioma, there have been the two methods; namely, the fractional dose and the massive or intensive. In the early days of radiotherapy, on account of burns, it was not uncommon to give very small and divided doses covering a long time, even for the treatment of small epitheliomata. Those of us who are familiar with past results will remember that a percentage of cases was permanently cured and some cases were improved up to a certain point and then, after remaining quiescent for a period, began to take on malignant tendencies again, and that some advanced cases were unaffected by the mild treatment. It has been proved that the long radiation, and often repeated mild exposures, are an ineffective method using any form of radiation. The dose may be divided into a few strong treatments, but not into an unlimited number of mild exposures. It is a fact that from the beginning of radiotherapy, the best results were obtained by those who gave strong treatments, and relatively few in number. When treatment is given by a method which produces no visible reaction by an operator who is afraid to give the full dose promptly and continued for months, such treatment will often leave the tissue degenerated instead of leaving a soft, smooth, and pliable scar. When such is produced by faulty technic this degenerated tissue must be removed surgically a healthy flap turned in as advised by Porter in treatment of ch roentgen ulcers on the hands of some of the operators.

Further treatment with radiation will bring only disappoint and lessen the chances of a cure. Often a surgeon is not de with a malignant condition and if so it is usually of a low de It is often difficult to convince the consulting surgeon of this Epithelioma is carcinoma of the skin and the successful meth treatment involves the complete destruction of all carcinom tissue. It has required clinical experience and judgment to when this has been accomplished.

So you can readily see the operator faces a serious probl deciding the proper form of radiation and dosage for each The operator having a case referred, must determine the ty the epithelioma, its situation, extent, the danger of metastase the form of radiation which is the most effective before he is to give a prognosis. Unless he has had a clinical experience as as being able to produce the desired reaction at the proper d he is unable to determine whether it is a case which can be by radium alone, whether other adjunct measures are necessa whether radium should be used as an adjunct to some other of treatment.

We have four classes of epithelioma in regard to method of t ment: first, the lesion which can be cured by one applicati radium with the proper dosage; second, the lesion which situated that glandular involvement is likely to take place o already occurred and the roentgen rays should be employe an adjunct to treat the adjacent glands; third, those cases in w the local application of radium supplemented by the roentgen will only act as a palliative measure, and fourth, those in which excision is justified to be followed by radiotherapy.

A marked reaction by radium heals up more promptly than action of the same degree by the roentgen rays. This is a valu point in deciding which form of radiation to use in certain c

There have been many methods of treating epithelioma ran from the internal administration of arsenic to radical sur removal. It is a well-known fact that superficial caustics have applied to cases which simply increased the blood supply stimulated the growth. All irritating procedures which are i are to be condemned as they are worse than no treatment at as before stated partial removal is always contraindicated. fact was realized by the older physicians and was one of the rea many of them still advise their patients to leave an innocent looking lesion alone until it bothers them. The results by radium and the roentgen rays are changing the views of many of these few physicians. At the present time, among many of the best physicians, there is a strong tendency to condemn the use of some of the older and inadequate measures which have kept the patient from seeking early treatment. The principal cause of failure might be attributed as much to an inaccurate technic in the use of the method employed as to the patient going late, with a large amount of glandular involvement. Until lately the value of a legitimate, conservative and nonsurgical method of treatment in most cases has never been strongly advocated. As a result of the tremendous strides made in radiotherapy, practically all the late surgical authorities today recognize its value as a legitimate method of treatment. They agreed that radium has clinically demonstrated its power of changing and destroying cancer cells more or less permanently with the least possible inconvenience and deformity and the best possible end results.

The excision of an epithelioma is justified only in cases which demand the removal of the contiguous lymphatic glands at the same time. Except for cases of this sort, excision, in my opinion, is not the most efficient method of treatment. Excision necessitates a sacrifice of a large amount of healthy tissue. With the most radical operation there is apt to be left outlying malignant cells. Therefore, recurrences are common after excision. The improvement in surgical technic and the recognition of careful handling of both healthy and diseased tissue, as well as the wide extirpation of tissue involved, has lessened the number of recurrences. But no difference how wide the removal, as before stated, it is not wide enough, and frequently there is a recurrence in the scar. It is to be remembered that recurrences after removal are regularly more malignant, more rapid in progress, more prone to metastases than the original lesion. Most surgeons realize that an incomplete operation is as powerless for palliation as it is for a cure. Partial operations are therefore contraindicated in any form of epithelioma the same as any form of malignancy.

Radium and the roentgen rays, I believe should always be considered first in treatment of epithelioma, because, when properly applied, practically all epitheliomatous tissue can be made to disappear, and there are fewer recurrences than by any other method. It is a perfectly legitimate method of treatment in proper hands

but is a method liable to abuse if it is not restricted to its pr
field.

Epithelioma of certain locations, on account of special featu
warrants brief separate description. This is on account of
nature of the tissues as well as the lymphatic supply. The virul
of an epithelioma increases or decreases proportionately with
richness or poverty of the lymphatic supply. In giving a progn
of an epithelioma, besides location, the several factors to be
sidered are in the variety, extent, duration and rapidity of
process. In all instances, the earlier the treatment is instituted
less chance is there of a recurrence. In many superficial for
the disease if neglected is slow in its progress, but eventuall
will become dangerous to life if left untreated. In the earl
stages when the disease is limited on the face and of the superfi
type, treatment is almost invariably successful and permanently
Even when moderately advanced, the results are usually favora
The same may be said of the deep seated and papillomatous for
if not of too long duration, but in these cases glandular involvem
occurs early. Cases in which marked destruction has already tal
place and in which there is considerable infiltration of the s
rounding tissues, and of long duration, the prognosis as to a p
manent cure is not so favorable, and particularly so if the gla
are invaded. Rodent ulcer is very amenable to treatment ea
but when allowed to have full sway and cover a large area, i
of a serious nature because this type of epithelioma seldom
vades the glands but destroys everything in its way.

Epithelioma of the upper part of the face, unless it has invol
cartilage, or bone, is more amenable to treatment than in any o
location. In the early cases one application of radium would
ally effect a cure. Radium is one of the most effective agents in
treatment of epithelioma of the eyelids. It can be brought in
tact with the lesion and there is little or no danger to the eye;
if the cartilage is not invaded, it requires only a small amo
of radium to effect a cure. If caustics have been employed,
cartilage is usually involved, and it is much more resistant to tr
ment and recurrences are more likely. The cosmetic results
superior to any other agent unless it is the x-ray. Frequently w
treating an extensive lesion you will expect that, if the lesio
healed, a large amount of deformity will result and to your
prise there is scarcely any deformity except the removal of
eye lashes. The reason for this is that the resulting scar is smo

pliable, and not thick and elevated like that following caustics or even a cutting operation.

Epithelioma of the nose and ear is easily cured if the cartilage is not invaded, but if invaded it is very resistant. The ear is particularly so, and, if the greater part of it has been removed by pastes or caustics, the glands are usually invaded and you have a very difficult if not a hopeless case to treat.

Epithelioma of the lower lip, however innocent in appearance, often shows a degree of malignancy that is not usual in other situations. It seems to be rather a regional than a local lesion. The lymphatics which drain it are early invaded and the results in the past from a surgical standpoint have been far from satisfactory. However, until recently the routine treatment has been early surgical removal of the ulcer and lymphatics. Until the introduction of radium and the roentgen rays there was no alternative treatment. Severe caustics would occasionally destroy the growth, but the resulting scar was large and retracted, and the percentage of recurrences was very high. Even after operation the results of recurrences were so frequent as to lead the more careful surgeons to refer these cases for postradiotherapy. Today it is an open question whether the general practitioner is justified in referring these cases for radiotherapy.

In deciding these questions let us consider the results which have been accomplished in the past by surgery alone. Murphy has shown us that in early surgical removal even when radically performed, a recurrence takes place in over 50 per cent of the cases where there are no palpable glands at the time of operation, and in over 75 per cent when there is any glandular involvement whatever. I believe better results can be obtained by radiotherapy. There are a number of radiotherapeutists who have had sufficient experience in epithelioma of the lower lip, and whose results justify them in considering radiation a perfectly legitimate method of treatment. However, the cases should be selected and treated by an experienced radiotherapeutist. Too much caution can not be directed against inefficient work which is being done by those who have just bought apparatus and have received instructions from manufacturers. Guided by these experiences, I believe that radiotherapy, by the means of radium and the modern roentgen tube, at present constitutes the best routine treatment of epithelioma of the lower lip, both at early and late stages. Experience leads me to a firm conviction that whatever position you may take today you will ultimately agree with this conclusion. There has been much haggling surgery of lip cancers and it is hoped that this chapter n not encourage haggling radiotherapy in the same field. The experienced, with recklessness, founded on ignorance, may bur ease; but he is scarcely more dangerous than the slightly perienced and overcautious radiotherapeutist giving insuffici dosage which may stimulate a growth to activity.

Epithelioma of the back of the hand usually responds to tr ment, but the progress is not so favorable as with the ordinary f cases because the axillary glands are often early invaded. Th fore small lesions should have prompt and thorough treatm No one realizes this better than the roentgenologists who have l keratosis on their hands. Some authorities state that progress epithelioma in this situation is slow and there is less liability grave ulceration than epithelioma in other situations. This has been my experience entirely. They have usually been slow progress, but the lymphatic glands were all invaded in the f cases that I have seen at the time they were referred.

Epithelioma of the genitals is always a serious matter, althou with the proper treatment in the beginning the results are oft successful. Left untreated until far advanced, palliation is a that can be expected from any form of treatment.

Paget's disease or eczematous epitheliomatosis of the nipple classified by most dermatologists under epithelioma or carcino of the skin. It is like superficial epithelioma, the onset is slow the condition suggests an eczematous involvement of the areola the nipple. The process begins with a moderate inflammation hibited as redness and scaling involving the nipple areola. La the surface is intensely red and granulating, exuding a copiou clear, viscid secretion and producing subjective sensations of h and burning with intense or moderate itching. When the dise progresses, cancerous infiltration of the breast is usually recogni and is one in which the malignancy is usually of a high deg In the *Year's Progress Medicine Surgery*, 1915, Murphy called tention to Paget's disease and stated that when very little p mammillary irritation was present there was a mortality over 90 per cent of the cases even when submitted to surgical eration. The reason for this is that the patients are usually f treated for eczema and are not given proper treatment until disease is advanced. They try almost everything and yet from very first it was cancer. Paget's disease is always malignant should be called Paget's cancer.

Paget's disease when seen early I believe, can be as successfully treated with radium applied locally, supplemented with a thorough course of roentgen radiation to the surrounding breast and adjacent lymphatics, as by operation. I have treated a few cases and whether it was my good luck or whether the cases were referred sooner than those which were operated upon, my results have been very gratifying. This corresponds with the experience of many others. Besides the patients will submit to radiation long before they will to operation. One case was treated eight years ago and the patient has never had any recurrence up to the present time. If these cases were referred early when there was only the eczematous condition present and treated thoroughly, the results would be rather uniformly successful. It is to be remembered in all cases there is no attempt at repair, and when abandoned to its course, the ultimate result is a profound ulceration with the destructive effects most noticeable in the region of primary invasion, the entire breast becoming cancerous and invading the lymphatics. Paget's disease occasionally affects other parts of the body such as the scrotum, penis, buttocks, vulva and perineum, as well as other parts of the body. In the extramammary cases it is agreed by most observers that radium and x-ray give the best results. It is to be remembered that local treatment suggested for eczema has no effect on this condition.

While it has been shown that all cases of epithelioma, when taken early, can be successfully treated and cures effected by radiotherapy, it should be borne in mind, on the other hand, that when cases have been operated upon for any reasons whatsoever, the operations should be supplemented with and followed by treatment with roentgen rays in order to obtain the best end results.

Cancer of the Mouth and Throat.—In the treatment of malignancy of the mouth and throat with radium, results have been obtained in a sufficient number of cases to entitle its use to consideration in every case, whether alone in small lesions, as an anteoperative procedure, or as a palliative method in hopelessly inoperable cases. And since even the smallest lesions are very prone to recur locally, and the adjacent glands are so early invaded, radiotherapy should follow surgical removal of even the smallest growth.

In all examinations of the mouth and throat, precancerous lesions such as leucoplakia, should always be looked for and treated promptly. Many of the earlier epitheliomata, before they have invaded the deeper tissues, will respond to one application of radium. It is always advisable to have a consult [illegible] ienced laryngologist before applying radium, and the gravity of innocent-looking lesions must not be overlooked or treated by inert methods. It is to be remembered that the persistent lesions in the mouth and throat are nearly always malignant or luetic. Superficial cautery seldom removes a malignant lesion and nearly always hastens metastases.

Whatever method is selected it must be done thoroughly. It is sad to state that so many cases are referred after superficial cautery has been employed and the growth has not only been aggravated, but deep metastases have taken place. Many physicians, not realizing the malignancy of these lesions, will often first try cauterization or some inert mouth wash, allowing the disease to become far advanced before they refer their patients to a laryngologist or for radium treatment. There is no place where it is more important to have early and proper treatment than in the mouth and throat. The selection of the method depends not only upon the location and extent of the lesion, but also on the experience of the operator or the radiotherapeutist. The brilliant results obtained have induced some laryngologists to consider radium as primary treatment. But if good results from this treatment do not follow in a reasonable length of time, then the advisablity of coagulation or operation must be considered.

Roentgenization of the lymphatic glands should always supplement radium therapy. The object of roentgen therapy is to control and destroy metastases in the adjacent lymphatics. The glands should be treated by roentgen therapy in the early cases because no one is ever able to tell how early the glands are invaded. Experience should have taught this to every surgeon and laryngologist as well as to every radiotherapeutist. With the roentgen rays, larger areas can be treated, and it is more practical than radium, when treating the entire cervical chain of glands. But, inside the mouth, the results of the roentgen rays can not be compared with those of radium, since the latter has the advantage of coming in close contact with the disease. Then, too, we are able to give a much heavier dose by radium, even producing a caustic reaction which will heal in from 2 to 4 weeks, whereas, if this dosage were given with a Coolidge tube of the ordinary type or even with the one which has been suggested for cavities, the caustic reaction would not heal for months, or probably never. A slough might be the result.

In some cases it is advisable to follow radium treatment by electric coagulation. The advantages of electric coagulation are: the destruction of tissue without opening the blood and lymph vessels, and the prevention of dissemination which might occur with a cutting operation. The large amount of tissue which can be destroyed by electric coagulation without hemorrhage, is an item of great importance, which compels serious consideration by those who have treated many malignant cases. However, a preliminary application of radium in advanced cases is always of great service, as we have no other agent which destroys cancer cells to the same extent, and at the same time sterilizes the tissues.

In some cases after radium has been pushed almost to the caustic stage, it is advisable to remove the growth surgically. I have seen a few hopeless cases, where results have been obtained by this method, which would otherwise have been impossible. This is more often true where the malignant growth starts in the tonsil than the buccal mucous membrane. The best method to use is that by which all the cancer cells can be eradicated, leaving as little scar contraction and deformity as possible, because a recurrence in the scar frequently takes place, especially if it is contracted and irritated by movement. Therefore, by whatever method the disease is eradicated, unless the resulting scar is healthy, pliable and free from contraction, it should be removed surgically.

Sarcoma in the nasopharynx is much more amenable to radium treatment than carcinoma. Sarcoma, even in cases where half the throat is filled with the growth, will frequently disappear in from four to six weeks after radium treatment. One such patient whom I treated with radium has remained well two and one-half years. This is really remarkable because his throat was almost filled with a mass and he could scarcely swallow or speak above a whisper. I had another patient in whom the sarcoma started in the tonsil; three operations had been performed, and within five weeks after the last operation, there was a recurrent mass which filled two-thirds of the throat. Within six weeks after radium treatment, the growth had entirely disappeared. Did space permit, quite a number of similar cases could be reported.

While, as before stated, carcinoma of the mouth and throat is not so amenable to radium as is sarcoma, still some results have been obtained. For the sake of description superficial lesions may be called epitheliomata, and those which have invaded the deeper tissues carcinoma. If ulceration is confined to the superficial layers of the buccal mucous membrane and has not spread to the teeth, one application of radium will frequently heal the lesion. But if the ulceration has to any extent invaded the muscle tissue, it is very resistant to radium treatment. Such cases should be given sufficient radiation to produce a marked reaction. This will usually disappear in from 2 to 4 weeks when electric coagulation should be employed rather than a repetition of radium. This will usually heal promptly leaving very little scarring, and no contraction of the surrounding tissues. If the gums are involved, the teeth seem to act as an irritant, and the cancerous process spreads readily, but if they are extracted, it seems to only aggravate the condition. What has just been stated in regard to the buccal mucous membrane, will apply to the tongue, except that the muscle tissues are earlier infiltrated and the glands are earlier invaded.

Carcinoma of the tonsil and nasopharynx is seldom seen until glandular involvement has taken place, therefore, the results obtained by radium in this location, must, as a rule, be considered from a palliative standpoint. It is advisable to give sufficient radium to produce a marked reaction. This checks the growth and sterilizes the surrounding tissues, and may make the case operable By combining radium with operation, some cases have been at least clinically cured, where only palliation could have been produced by radiation alone, and where operation by itself would have only made the condition worse, because the disease could have been but partially removed.

I am convinced that if radium were employed as a routine procedure, in early cases often no other treatment would be necessary, and in advanced cases when followed by coagulation or operation, better end results could be obtained. I also believe more can be accomplished by raying the adjacent lymphatics, than by removing them surgically, because if the glands are palpable, operation seems to hasten, rather than to retard the malignant process, since it is very seldom that all the cancerous cells can be removed.

Sarcoma.—Sarcomata do well under treatment of both radium and the roentgen rays, if treated before dissemination into any of the internal viscera has taken place. The best results are in lymphosarcoma, where the results seem to be just as good when treated by radiotherapy alone, as when the growth is removed surgically followed by the roentgen rays. Sarcomata in other locations should be removed surgically, followed by radiotherapy. It has been suggested that borderline cases should have anteoperative radiotherapy. Under radiation large tumor masses gradually diminish in size, smaller glands disappear, while secondary glands also clear up. The round cell variety seem to be the type of growth most easily influenced by radiation, while the spindle variety is not so readily dealt with, probably because it is a more active type of growth.

There is a tendency for sarcomata to recur within a year or so, and often in the deeper parts, particularly in the lungs and mediastinum. It has been long realized that nearly all sarcomata recur within six months to two years after operation. Therefore, after a sarcomatous growth has been removed surgically, the patient should be irradiated over the whole area as soon as possible after the operation. It is of extreme importance that it should be carried out thoroughly. The difficulty lies in the fact that unless great care is exercised to irradiate the whole area thoroughly, experience has shown that recurrence often takes place in areas which have escaped treatment. The whole area to be treated should be mapped out, and central points selected which will get the maximum dose. The results of prophylactic treatment are encouraging, the patients are less pained, the movements of the parts are facilitated, and the scar is less, and more pliable after radiotherapy. That recurrence may be prevented in a certain number of cases is well established, especially in view of what we know occurs when early recurrences are treated. It is logical to assume that remnants of the disease left in the wound or adjacent tissue will disappear in the reparative changes set up in the surrounding tissues by radium or the roentgen rays. Sarcomata will frequently recur after operation under mild treatment, but will disappear under intensive radiation.

CHAPTER LIV

REAMPUTATIONS

By Willard Bartlett and Walter S. Priest, St. Louis

The recent war has made necessary a much greater percentage of reamputations than is found in average civil practice. In consequence a number of contributions to the subject have appeared in the literature within the past four years.

The complications and conditions arising after a primary amputation which require a secondary, or reamputation, can be determined for any individual case by the attending surgeon. Reamputation is necessary and intended from the outset where conditions attending the primary operation are such as to necessitate the "guillotine" or "flush" method of amputation introduced by Fitzmaurice-Kelly.[1] Such conditions are occasionally met with in civil practice, but are frequent in military surgery where the presence of gas gangrene makes such a procedure necessary to life saving. Another condition, seen frequently in military practice, where reamputation is employed, is the so-called "trench foot" in which simple trimming away of necrotic tissue is done until healing is established.[2] Such a course is justifiable inasmuch as such lesions often recover to a surprising extent, and save tissue that would have been thought necessary to remove earlier. In the end, though, such stumps are either bad functionally or do not heal completely, hence the necessity for a selected, formal reamputation.

Whenever possible, reamputation should be avoided by careful primary amputation with proper after-treatment, as reamputation is accompanied by considerable shortening of the stump with the possibility of greatly lessened function, and entails no little hardship on the patient. Merely sawing off a few centimeters of bone at the secondary operations does not constitute a satisfactory reamputation. It is necessary to conduct the secondary amputation along some of the approved lines for primary amputations or some modification thereof.[3]

There are some general considerations to be taken into account in planning a reamputation.[4] The skin flaps need not be long. About the foot, a Syme operation gives a stump adapted to a mechanical ankle and is end bearing. The site of election in the leg is the middle third and in this region the osteoplastic method of Bier is strongly recommended as productive of the best results. Unless the distance from the posterior surface of the thigh to the end of the finished leg stump is at least five or six centimeters, a below-knee artificial limb can not be used, and amputation should be done above the femoral condyles. Every inch of the thigh until the upper third is reached is valuable, and unless the end of the stump is at least two and a half inches below the lesser trochanter, a thigh bucket can not be worn, and operation through the neck of the femur, or at the junction of the shaft with the greater trochanter with intention of using a hip bucket, should be done. In the upper extremities all fingers possible should be saved. To within three inches of the olecranon process all of the forearm is valuable. Above this it is best to do a supracondylar humeral operation. All of the humerus is valuable and the shoulder joint is useless unless one and a half inches of the humerus below the anterior axillary fold are saved.

As soon as possible following operation the stump should have massage, passive motion, and gradually increasing end pressure by means of roller bandages after the method of Hirsch.[5] Psychically painful stumps have been observed due to the depressed mental attitude of the patient,[6] cheerfulness and optimism on the part of the surgeon as to the eventual usefulness and painlessness of the stump as well as careful attention to provide cheerful surroundings during convalescence often make much for success. In cases where it is known from the outset that reamputation is to be done, the skin should be kept from retracting by strips of adhesive and weights arranged so as to apply gentle traction at all times.

Osteoplastic Reamputation.—As the art of surgery advances, more responsibility is placed on the surgeon in securing good amputation stumps. For some time an effort has been made to perfect stumps of the lower extremities with respect to end bearing, in addition to making them capable of supporting the weight of the body through an artificial limb applied by means of a cuff or bucket laced around the stump. The obstacle to the successful application of a prosthesis which depends solely on the fit of the cuff is readily seen when one considers the atrophy which the soft tissues are certain to undergo. While such an artificial limb usually serves its function well when first applied, the gradual decrease in diameter of the stump makes necessary a constant readjustment and padding of the bucket to make it fit snugly enough, and eventually a good fit may be impossible. In order to make possible the placing of some of this strain on the end of the stump, i. e., to make the stump end capable of bearing weight, various procedures have been devised.

It has long been recognized that the heel is nature's example of a properly constructed, weight bearing stump. Therefore, efforts should be made to approximate the conditions found there as nearly as possible. To accomplish this Bier devised the osteoplastic method of amputation. His work began in 1891, thirty-seven years after Pirogoff introduced the subject. Bier's[7] first contribution to the subject appeared in 1892, but the type of "peg-leg" for which this operation was devised is now seldom seen. His next contribution, the one with which we are concerned, appeared in 1897[8] and dealt with amputations in the middle and upper thirds of the leg. The technic as modified by Kocher[9] and Storp[10] is as follows: an anteriomedial elliptical skin incision, the lowest point corresponding to the inner surface of the tibia, is made and carried down to the muscles and periosteum (Fig. 186). At the level of the apex of the flap the periosteum is divided transversely across the medial surface of the tibia and reflected upward sufficiently to permit a small wedge of thickness not quite extending to the marrow cavity, to be removed from the bone thus laid bare (Fig. 187). The skin

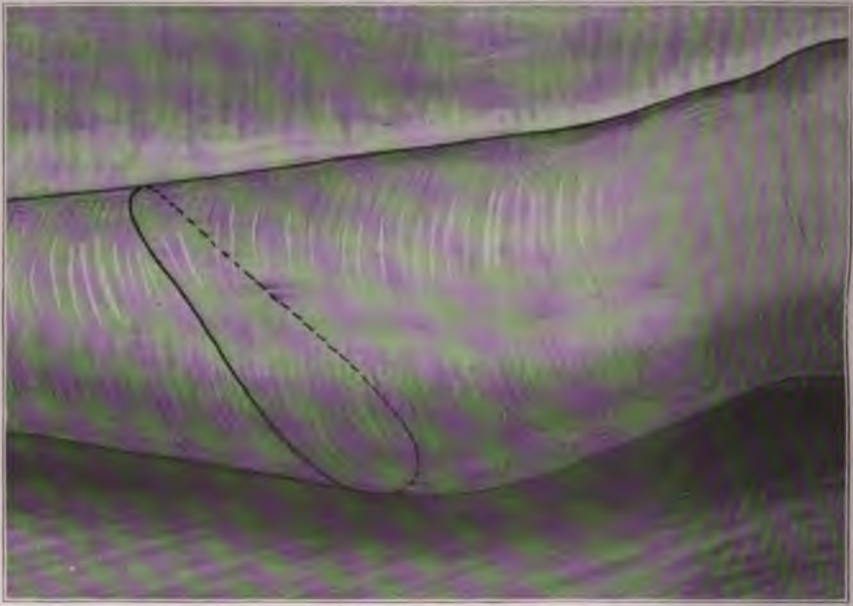

Fig. 186.—The direction of skin incision.

is retracted along the tibial margins and a rectangular flap of periosteum marked off by longitudinal incisions directed proximally along the tibial borders (Fig. 188). By means of a Gigli saw introduced into the wedge previously made, a rectangular bone flap, corresponding to the periosteal flap already outlined, is reflected by sawing parallel to the inner margin of the tibia. The normal continuity of skin, fascia, periosteum and bone is disturbed as little as possible. When the desired length of bone flap is thus sawed, it is severed at its base by manipulating the saw in a vertical direction a few times, then breaking it across with an elevator, great care being taken not to injure the periosteum. The periosteum is then stripped up about a centimeter further in order to provide an ample periosteal hinge for the bone flap. Thus, we have an anterior flap consisting of skin, fascia, periosteum, and bone. The muscles are now divided at the proper level parallel to the skin incision, and the tibia divided at the level where periosteum leaves bone. The fibula is divided at a somewhat higher level and is not covered by a bone flap. The bone flap is now sutured over the end of the tibia by means of its periosteal covering (Fig. 189); the vessels secured and ligated; the nerves divided as high as pos-

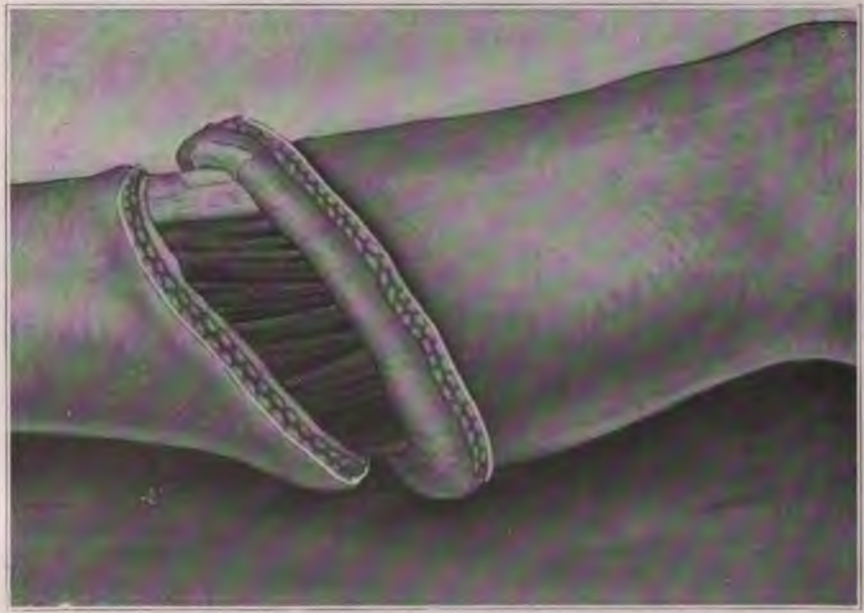

Fig. 187.—Incision through skin, deep fascia and periosteum.

sible; the muscles sutured; then the fascia and finally the skin, leaving a posterior scar extending about half way around the stump. It is well to place the three layers of sutures so that they are not directly superimposed upon each other, otherwise a hard, deep, contractile scar will result. After the soft tissues over the end of the stump have undergone fibrous union, a well-formed stump (Fig. 190) capable of supporting the body weight or a part of it should result.

Other osteoplastic amputation procedures described[11] are: Ssabanajeff's femorotibial amputation, through the femoral condyles in which a bone flap from the upper anterior portion of the tibia is used; the Stokes-Gritti supra-condyloid operation on the femur in which the anterior half of the longitudinally divided patella with its superior tendinous attachment intact is used as the bone flap. Chapple[12] speaks highly of this operation in a recent publication and offers a modification which he claims overcomes the failures of the operation which have caused it to lose favor. To these failures he ascribes the upward pull of the quadriceps extensor tendon and also the mechanical devices used to keep the patellar flap in place. He does away with both these features by freeing

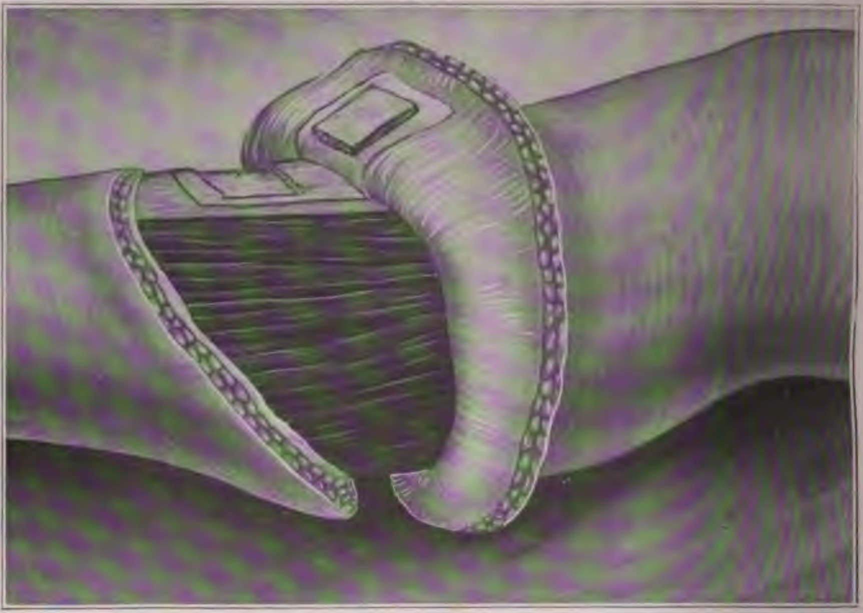

Fig. 188.—Periosteum and bone flap elevated.

the flap from all tendinous attachments and fixing it in place by periosteal suturing.

While the above operations were designed originally for primary amputations, they are equally applicable to reamputations in corresponding regions.

Osteoplastic reamputations can likewise be carried out on the thigh with the prospect of equally good results so far as end bearing is concerned. Modifications of Bier's technic should be used.

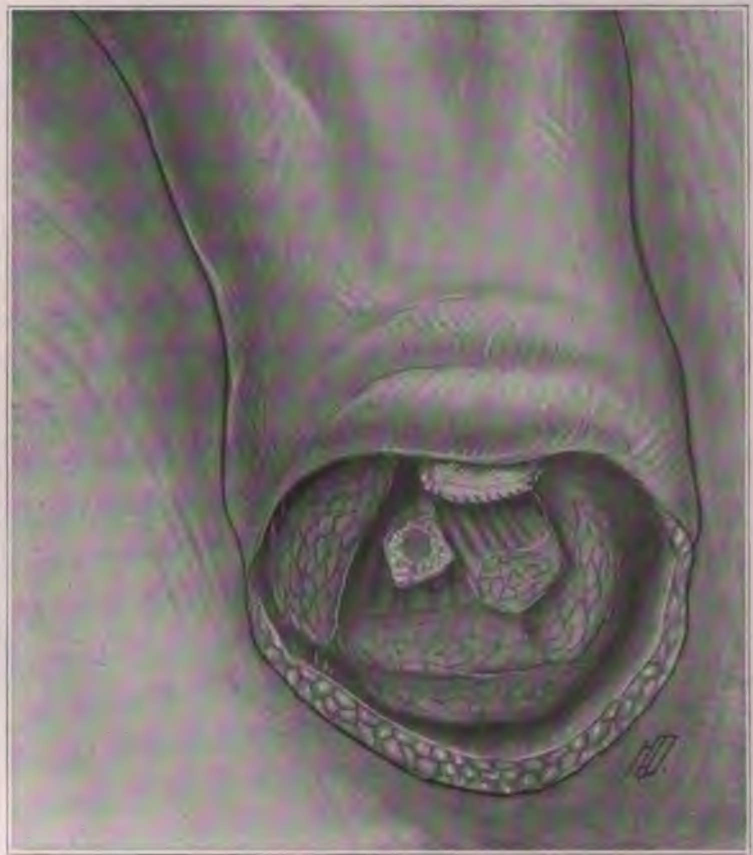

Fig. 189.—Bone flap sutured in place after complete division of all structures at a high level.

Other Methods of Reamputation.—Chapple[13] of the British Army who had a large series of cases requiring reamputation following guillotine amputations done at the front where conditions were far from ideal and where amputations in a great many cases were emergency operations in the truest sense of the word, sets forth some factors of value in treating such cases. It must be remembered the patients were in a bad condition generally when received and their stumps presented conical granulating and suppurating ends from which the skin and soft tissues had retracted leaving various lengths of exposed bone, often sequestrated. Not only were such stumps seen following the guillotine amputation, but it was not uncommon for patients to present themselves with stumps made by one of the regular flap methods in which the flaps had broken down and retracted, leaving a similar condition.

In brief, the technic outlined by Chapple as described by Neve[14] is as follows: (1) Curette granulating surfaces, paying particular attention to any pockets. (2) Expose the bone through a longitudinal incision on the outer surfaces of the stump. (3) Peel periosteum back without using longitudinal incisions. (4) Cut the bone at the lowest possible level with a Gigli saw. (5) Trim away any soft tissues injured in sawing, free the skin from soft tissues and trim ragged edges, avoiding injury to subcutaneous fat. (6) Attend to hemostasis. (7) Introduce a purse string suture into the periosteum infolding it as a cuff over the end of the bone, thus preventing the formation of painful spurs. Suture muscles. In-

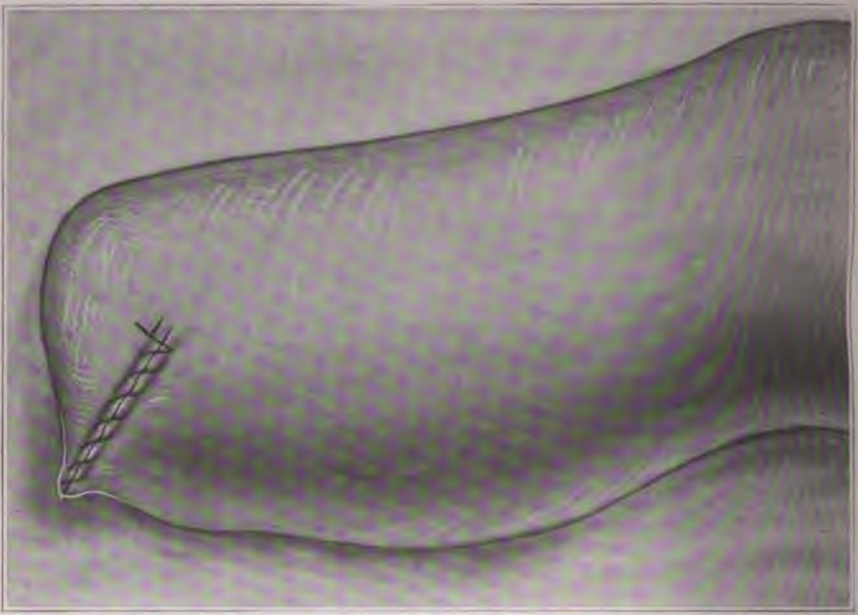

Fig. 190.—The stump with flaps sutured.

troduce tension sutures "staple-wise" from one to one and a half inches from the skin edge and tie while skin flaps are held securely in position. Suture the skin edges. Drain with rubber tubes at each end of the incision.

The button sutures which form the essential part of this technic are composed of heavy silk threaded through oval buttons of vulcanite. If these are not at hand, India rubber tubing may be used. The theory on which the importance of these sutures depends is that "tension and not pus is the enemy of union" and that even if the skin sutures break down and suppuration occurs, a sort of secondary union will take place because the tension sutures hold the skin edges closely enough together so that when suppuration ceases, the epithelium bridges the narrow gap without difficulty. If suppuration is excessive, drains may be inserted between the skin stitches. These stitches do not serve to hold the skin edges together especially, but prevent bulging of the subcutaneous tissues.

Advantages claimed for this technic are: less loss of stump, long skin flaps are not required; muscle and tendon ends are kept together over the end of the bone which ultimately undergo fibrous union and furnish greater motive power to the stump, the muscles do not retract up the bone; hematomata are prevented; the vascularity following the primary operation is used to combat suppuration and shorten convalescence.

Flapless Method of Reamputation.—This method is described by Handley.[15] Two parallel incisions are made on the lateral surface of the stump at the desired level of bone division, and about one third the circumference of the femur apart. A curved forceps is introduced into one incision and worked around the bone until it grasps the end of a Gigli saw introduced in the other. It is then withdrawn, bringing the end of the saw out through the first incision. The saw may be protected by tubular guards. The direction of the saw cut is always from the main arterial trunks so there is little if any danger of injuring them. After the bone is sawed through, an assistant grasps the end of bone protruding from the end of the stump with lion-jaw clamps and exerts traction, while the operator detaches the muscles with the aid of a periosteal elevator. Any necrotic or calcified tissue is trimmed away from the end of the stump, and after attending to hemostasis, the skin edges are sutured and drained.

Maryland[16] uses a chain saw instead of the Gigli in doing Handley's operation, and also makes lateral incisions three to four inches long extending to the bone. A silk ligature is used to guide the saw. Carbolic oil dropped on the chain is used to prevent necrosis of the bone. By this method and its modification, there is a minimum exposure of fresh surface to infection in septic stumps and maximum conservation of tissue.

Apparent Lengthening of an Arm Stump.—In arm cases where it is not possible to leave a stump of sufficient length to provide for the attachment of a mechanical arm, Smith[17] has devised a method of apparently lengthening the stump. The operation consists in making an inverted horseshoe incision into the axilla, the ends of the incision being well within the borders of the axillary space. The insertions of the pectoralis major and latissimus dorsi are divided to about one-half their length distally, the arm being held in the abducted position meanwhile. The divided portions of these muscles are then sutured high up into the axilla and the incision closed with the arm still in the abducted position; the line of incision changing from a "U" to a "Y." In the case reported the length of the stump was increased, functionally, from three-fourths to two inches and allowed the successful application of a prosthesis controlled by the stump.

Kineplastic Reamputations.—In suitable cases, reamputations of the upper extremities offer a fertile field for the application of the principles of kineplasty, or cineplasty, as it is sometimes called, in order to obtain the maximum function of the stump.

In 1896, Vanghetti, although not a practicing physician, became interested in the possibility of using the contractile power of muscles and tendons of amputation stumps to activate the mechanism of a mechanical prosthesis. His report of experimental work on animals was published in 1899[18] and the following year Cici first applied in a practical way the principles set forth, using them in an arm amputation. Later in the same year Codivilla demonstrated the applicability of the method to amputations of the lower extremities.

The idea, although described in some of the works on surgery published after that time, was not used to any great extent until the recent war furnished such a quantity of material concentrated in favorable institutions under conditions permitting a careful study of its merits. Gaudiani[19] in this country and Putti of Bologna and others have recently urged a wider employment of this method in reconstructive work and in reamputations as well as in primary amputations. Putti, in an address before the British Royal Society,[20] urged that, where time and other conditions do not permit of such a procedure at the primary amputation, the surgeon should operate in such a way as to make the future application of kineplastic principles possible. To this end, as much osseous and contractile tissue as possible should be saved; the muscles and tendons being kept from retracting.

Besides providing for the transmission of motion from the stump to the prosthesis, a simpler and firmer means of attachment of such an artificial member is supplied.

The meaning of kineplastics as given by Vanghetti is "any kind of bloodless or operative plastics which tend to economise, restore, or substitute muscular masses which can be employed towards imparting direct and voluntary movements to an artificial limb." Needless to say the variety of operations possible under this head is limited solely by the surgeon's skill and ingenuity. The moving unit or units so obtained are called by Putti "motor flaps." Any contractile tissue may be made to serve as such a unit provided it has means of securing nourishment and is covered by normally functioning skin.

Certain requirements on the part of the motor flap must be met. It must be capable of withstanding considerable traction; must be painless; must be of such size and shape as to permit the application of loops, hooks, cords, and other mechanical devices for connecting it with the mechanism of the prosthesis. A covering of intact normal skin is paramount in meeting these requirements.

It is obvious that in selecting the structures to form such a flap, the normal anatomic relations and physiologic function of such structures must be considered, and those selected which are most active in producing the desired movements. Tendons are especially desirable. Where these are not available, muscle bundles are utilized by constructing tunnels or "buttonholes" through their substance. Where possible, antagonistic groups should be used to make separate flaps. Missing essential elements may be supplied by various plastic procedures.

The cases suited for application of these principles are: (1) primary amputations (most desirable); (2) healed stumps prepared for kineplasty at the primary operation; (3) certain healed stumps resulting from the ordinary methods of amputation. Though most applicable to the upper extremities, the method may be used in work on the lower extremities to secure independent and voluntary control on the part of the stump over flexion and extension of the knee joint of the artificial limb after thigh amputation.

Stumps not suitable are those of which the skin is adherent, scarred, and of which muscles have atrophied to such an extent as to be only slightly contractile or which have ankylosed joints.

Willingness and patience of the subject to train himself to use the new member, and the cooperation of a mechanic skilled in making artificial limbs are necessary adjuncts to complete success. The best subjects are those between twenty and thirty years of age.

Technic.[21]—The single motor flap, the double motor flap and the "plastic club motor" illustrate the possibilities and variations of the method.

Single Motor Flap in Amputation Through the Arm.—A cuff consisting of skin and subcutaneous tissue is reflected from a circular incision four centimeters above the elbow fold, to the junction of the lower and middle thirds of the arm. The tendons of the biceps and triceps are severed; the nerves cut high; the soft parts retracted; a cuff of periosteum raised; and the bone sawed across in its lower third. The biceps and triceps tendons are sutured together to form a loop extending beyond the end of the bone. The periosteum is sutured over the end of the bone, using a purse string. About three centimeters from the border of the skin flap, two longitudinal incisions about five centimeters in length, one on the posterior, one on the anterior surface, are made. The cuff is then brought down over the tendinous loop and the corresponding edges of the buttonhole incisions sutured together, leaving a skin covered hole through the loop; after which the lower edges of the cuff are sutured. The "buttonhole" through the loop is kept patent with gauze until healing and cicatrization are complete. It is well to begin traction on the loop as soon as possible. When the prosthesis is fitted, suitable cords passed through the loop connect the stump with the mechanism of the hand, so that, when the stump muscles contract the fingers are flexed. Following relaxation of the stump, the fingers are relaxed by springs.

By suturing the tendons of the extensors and flexors of the forearm together, a similar operation can be performed on the forearm.

Double Motor Flap in Amputation Through the Forearm.—A circular incision through the skin and subcutaneous tissue is made and the skin allowed to contract. At this new level the muscles and tendons are divided circularly to the bone. Two lateral incisions, extending proximally for about five centimeters from the free border of the skin, one along the radius, the other along the ulna, are carried to the bone, thus forming two rectangular flaps of skin. Corresponding musculotendinous flaps are made. These flaps are retracted and the bones sawed across at the base of the flaps after providing periosteal coverings. The muscles and tendons of each flap are divided in equal parts and the two portions of the same flap sutured at their ends. That is, the procedure with each flap is essentially the same as with the single flap described above. In making the "buttonhole" ring in each flap, the corresponding skin flap is folded over the end of the musculo-tendinous loop. The longitudinal edges of the skin flaps are then sutured, and temporary drains inserted at the base of each flap. Similar after-care as described above is used. By connecting one of the motor flaps with the flexor and the other with the extensor mechanism of the prosthesis, the patient has voluntary control over practically all the movements of fingers, thumb and hand.

Amputation of Forearm Providing a Plastic Club Motor.—De Francesco[22] presents the following adaptation of Vanghetti's technic. After amputating in the usual fashion, longitudinal incisions about five centimeters in length are carried to the bone over the radius and ulna. Through these, about two and a half centimeters of each bone is removed by means of a Gigli saw, leaving about two centimeters of each bone in the distal end of the stump. The end of the stump and the longitudinal incisions are then sutured. During healing, a ring is placed around the forearm proximal to the bone fragments, and traction employed to prevent contraction. When healing is complete, this ring is replaced by one of padded hard rubber, which is held in place by the knob-like end of the stump, and suitable cords connect the ring with the prosthetic mechanism. The fingers are flexed by contraction of the stump muscles and passively extended when the muscles are allowed to relax.

A tenoplastic form of the technic has been devised by Vendrene,[23] and an osteoplastic operation for using the rotatory power of humeral stumps has been suggested by Elgart.[24]

Full credit is due Walter S. Priest for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER LV

PROCTOCLYSIS

By O. F. McKittrick, St. Louis, Mo.

The administration of fluids through the rectum has become a very common practice. When one considers that it is comparatively a new addition to the means at our disposal for making postoperative patients safer and more comfortable, one is no less amazed at its general use than at the excellent results obtained thereby.

This form of treatment is employed as routine with my own patients, though in some other clinics it is used in the more serious cases only. It is particularly indicated in all forms of peritonitis, in toxemias of any kind, and in supplying fluids to generally debilitated and dried out individuals, where the stomach is not available. Murphy,[1] who described an apparatus which was successfully used in his postoperative cases, was the pioneer in this field, and to him we are indebted for its universal use.

The giving of proctoclysis is indeed a very simple performance, but must be carried out with some idea of the laws of Nature, else one is impressed with the fact that she rejects ill-timed encroachments, and the fluid, therefore, is not retained. Murphy, years ago, stated the well-known fact that the normal large intestine is moderately distended, and that its mucosa absorbs water rapidly. Any overdistention, especially if suddenly produced, causes spasm of the musculature, with pain and expulsion of the material. The general principles upon which Murphy founded his treatment have not been changed, although improvements have been made in his apparatus from time to time.

His instrument consisted principally of a fountain syringe and a large curved hard rubber or glass vaginal douche tip. The syringe, filled with warm saline, was hung eighteen inches above the patient's hips, and the curved douche tip inserted into the rectum. The flow was then started by releasing a pinch cock on the rubber tubing. Fluid was thus allowed to gravitate to the rectum in drops, just as fast as they were absorbed; the flow was continued as long as it was tolerated or deemed necessary. By means of the large tip in the rectum, gas could be expelled through the tubing, to the reservoir, and thus this treatment could be continued several days, without very great inconvenience to the patient.

In the beginning it was considered highly important to have the fluid at body temperature as it entered the bowel. It was soon learned, however, that with such an apparatus as Murphy used, the fluid could not be maintained at an even temperature, since heat was applied to the reservoir only. Since the fluid in the bowel was constantly being absorbed, there was a continual change in the height and temperature of the fluid in the reservoir. In order to overcome this difficulty, Elbrecht[2] devised an arrangement, by means of which the saline could be heated as it coursed through the rubber tube. By this means the amount of the fluid in the reservoir, as an important factor was eliminated.

Elbrecht's device consisted of a metal heating chamber, which was block-tin lined, contained rubber tube connections for intake and outlet for the solution, and also an opening for an electric heating unit. This unit was connected by means of insulated wires to an electric socket. It could be used with either alternating or direct currents. The metal chamber when heated by electricity was put into the bed with the patient. When, however, it was heated by means of an alcohol or gas lamp it was placed on a small table at the side of the bed. The fluid, then, was heated to the proper temperature, just before it passed into the body.

Elbrecht also devised rectal tips of different sizes, to fit the individual case. This prevented the solution from escaping, or the rubber tube from pulling out. Each of these self-retaining, hard rubber rectal tips had a hole in the center, through which a catheter could be inserted. By means of them, an ordinary rubber catheter could be used instead of the hard rubber vaginal tip, which at times exerted too severe pressure on the rectal walls, or instead of the glass tip, which was easily broken. For diminishing the lumen of the tube, so as to get the required number of drops, he used a screw clamp, as shown in Fig. 191, page 589 instead of a hemostat or the clamp accompanying a fountain syringe. By means of the screw clamp, the saline could be regulated to any number of drops per second.

Elbrecht's[2] apparatus did not improve upon the one first used by Murphy, except that it was a most admirable arrangement for keeping fluid at an even temperature. It was also somewhat expensive, and therefore not generally used. Wechsler[3] used an apparatus which by heating the reservoir alone was designed to meet the same requirements as Elbrecht's. It was similar to Murphy's except that the reservoir consisted of a large irrigating glass container, around which was placed a water jacket. Into this jacket, hot water could be poured, and the salt solution thereby kept warm. When the water in the jacket became cold, it was drawn off by means of a stopcock. This arrangement was not only impractical, but also somewhat expensive.

Newman[4] devised a funnel arrangement, which, he thought, would overcome the expense of the regular proctoclysis apparatus, and yet answer the same purpose. His apparatus consisted of a large iron ring stand, which suspended two glass funnels, a large one to act as the reservoir, and a smaller one to allow escape of gas from the rectum, and also to convey the drops of saline from the reservoir to the rectal tubing, which was similar to that employed by Murphy. A metal bar placed over the top caused the saline to drop from the large funnel. This bar had an opening in its center, and at this point the nut of a screw was placed. A thin rod, which was connected to this nut, extended to a rubber stopper at the tip of the funnel, and by screwing the nut drops could be secured and regulated. An electric light bulb was placed in the lower funnel. Saline dropping from above first struck the light bulb, and was then conveyed to the rectum through the ordinary rubber tubing.

Newman's was the best apparatus devised to allow the escape of gas from the rectum, but it did not adequately heat the saline. For this reason it did not become very popular.

McLean[5] devised another apparatus, which consisted of a tin box containing a two quart dish. Under this was placed an alcohol lamp or an electric light bulb to keep the fluid warm. The tip of a glass funnel which extended through an opening in the box was so arranged that the top of the funnel was lower than the two quart dish which held the saline solution. Strips of gauze one inch wide connected the reservoir with the funnel below. A four ply strip of gauze freed fifty drops per minute, into the funnel, and the number of drops desired was regulated by changing the size of the strip.

An apparatus which previously was devised by Saxon,[6] combined the good points of those which have been mentioned, and in addition, had a thermometer placed in continuity with the rectal tube, so that the temperature of the saline could be ascertained at any moment. The reservoir was contained within a tank, permitting it to be surrounded with hot water, which when cold could be drawn off by means of a stopcock, and hot water added. A small glass cup on a glass "y" tube, served for an outlet. The objection to this apparatus was that it could not be conveniently carried from one patient to another. Babler,[7] therefore, devised a very simple apparatus, which consisted of two glass jars and rubber connections. The jar containing the saline was placed in the other larger jar, which contained hot water. The rectal tube and tip were the same as used by Murphy. The outlet for gas consisted of another rubber tube, which was connected by means of a "y" glass tube with the main rectal tube, and was held by means of a bent glass tube, to the side of the largest glass jar. The rectal tube communicated directly with the saline solution in the reservoir by means of bent glass tubing. If necessary, the jars could be replaced by any sort of vessels and this, with the small amount of tubing, made the apparatus desirable, but the number of drops could not be counted, and the amount of fluid going into the rectum could not be accurately known.

Lawson,[8] one year previous, in order to determine the rapidity of flow, used an ordinary medicine dropper, which fitted tightly into the center of a rubber stopper. This, in turn, fitted into the top of a barrel of a urethral syringe. This device did not allow gas to escape from the rectum, so Dewitt,[9] three years later, employed a similar arrangement, but simply punched holes in the stopper. This then proved an efficient instrument.

Many other appliances were devised, but none seemed perfectly satisfactory. Apparently, all operators were agreed that the gravity method was the best, i. e., the reservoir should not stand more than eighteen inches above the hips. It was also generally conceded that continuous proctoclysis was better than intermittent, since too often inserting even the simplest rectal tube, would cause irritation in the majority of the cases. The apparatus of Lawson, and others who employed funnels, overcame the error of being unable to see how much fluid entered the rectum, and the expelled gas was also easily taken care of, but none of these methods fully met all the obstacles encountered in giving fluid per bowel.

It seemed to be the prevailing opinion that the fluid should be at body temperature when it entered the body, in order to be absorbed more readily, and most of the devices were made with this point in view. It was not considered necessary to have the fluid warm in order for it to be nonirritative or absorbable. Considering the universally good results which followed the application of this treatment, regardless of the method used in applying it, one is not surprised at Weeks'[10] statement, for without doubt, in most instances, the fluid was cold by the time it reached the rectum. In our own cases, we have observed no difference in the absorption of the fluid, whether warm or cool, and we feel this is not an important point. However, we try to have the fluid warm in the reservoir, in order not to chill the patient.

The apparatus which we employ, combines all the good points mentioned above. It consists of an ordinary irrigating can, which holds one quart or more of fluid. The water which is used for the injection is poured into the can, and a temperature around 110° is maintained, by placing a bottle full of hot water into the water to be used. The outlet of the irrigating can is connected, by means of rubber tubing one-half inch in diameter, with a *glass dropper*, and this latter connects with the arm of a "y" glass tube. The other arm of the "y" connects with rubber tubing, which serves as an outlet for the gas, and suspends from the top of the reservoir by means of curved glass tubing, which is covered by the rubber tube. The foot of the "y" connects with a four foot rectal tube, at the end of which an ordinary No. 32 French catheter is attached by means of a short glass tube. The catheter is greased well with vaseline, and inserted six to eight inches into the lower bowel. It is held in place by means of adhesive strips adhering to the buttocks. The screw clamp, which is placed immediately above the visible dropper, regulates the flow perfectly. In instances where we are unable to secure the regular dropper, or a "y" tube, we employ Weeks' method, which in the main, consists in letting the water drop from the reservoir into a funnel, which connects with the rectal tubing. The drops are formed by utilizing the screw clamp. If this too can not be had, a piece of gauze, hanging from the solution, may be so employed as to allow the fluid to drop into the funnel. The use of the funnel is as useful a method as our regular apparatus. It is cheaper, simpler, and has other advantages. The funnel can be utilized in giving enemas to relieve gas pains or to remove collections of fecal material. Reinsertion of the rectal tip or catheter is not so often necessary when using this apparatus. If at any time the bowel does not tolerate the fluid, the funnel can be taken out of the hanger and the overflow in the rectum is syphoned off. This method is particularly useful in children, since from stoppage of the tube gas collects more readily, and the bowel is more irritable than in adults.

Physiologic saline solution was first considered by the pioneers in this field as the proper fluid for proctoclysis, and even today is used extensively. It is prepared by placing 8.5 grams of sodium chloride in a liter graduated flask, and then adding sterile distilled water until the 1000 c.c. mark is reached. A very common and comparatively accurate method is simply adding two level teaspoonfuls of fine table salt to one quart of water.

Unfortunately this solution has attained the name "normal salt solution," and has become so fixed in the minds of the majority of the medical profession, that the fallacy is not recognized. A normal salt solution[11] consists of the atomic weights of sodium and chlorine, 23 and 35.46, respectively, dissolved in a liter of pure water. It is made by placing 58.46 grams of sodium chloride in a graduated liter flask, and adding pure water up to the 1000 c.c. mark. Thus a physiologic salt, (that which is always used) and a normal salt solution are entirely different solutions. The former is an .85 per cent saline solution, while the latter is .5846 per cent salt solution. It would be quite a serious mistake to order "normal salt solution," meaning, all the while, the physiologic solution, and for this reason we feel justified in calling attention to this extremely common error.

The method of preparing "normal saline solution" was recently investigated by Trout, who studied the methods employed by 232 different hospitals and found that they "varied from the most careful attention to minute details, i. e., that the fluid contained potassium, calcium, and sodium chloride in varying proportions, filtered and sterilized, to the simple placing of two teaspoonfuls of table salt to one quart of tap water." A teaspoonful of salt, as Trout says, may be anything "from 115 grains to 270 grains, depending upon whether it is heaping or level." Considering the amount of saline which is given at times per rectum, the patient, under these circumstances, would be forced to take as much salt as is utilized as a condiment by a normal person in a month.

There can be no doubt that under many circumstances, large amounts of saline administered, promiscuously, as is so often done, are injurious to the tissues of the body. Bad results have followed its injudicious use in postoperative cases, with weakened hearts, and diseased kidneys. To this class of patients, Willmoth[12] would add those threatened with sudden death, dilated right heart, pulmonary edema, apoplexy, or arteriosclerosis. So often, patients with some kidney lesions, and even on a salt-free diet, are given the routine saline, after some operation has been performed. We can not reconcile such a procedure. Evans[13] called attention to the recklessness with which saline has been given in late years. He stated that "one can not fail to be impressed with the danger of such a procedure in postoperative patients, in whom saline solution is given without previous knowledge of the condition of the blood pressure, the ability of the heart to handle large amounts of saline successfully, or the functional capacity of the kidneys to excrete the large amount of chloride thus forced upon them." He also, rightfully, stated that patients have died due to the use of saline alone. Such cases usually escape reporting, since, as he says the cause of death is problematic, and since the saline is used in grave surgical emergencies, the death is attributed to other causes. When one considers the numerous ways the solution is prepared, and yet in each instance the physiologic salt solution is the result which all are striving for, it would be impossible to determine the countless number of patients suffering from the deleterious effects, from more or less poisoning due to overdosage of this substance. Actual death from saline given per rectum has been cited in a few instances in the literature. In a case reported by Brooks,[14] salt solution was used after an ordinary appendectomy, the nurse employed a stock solution of sodium chloride in preparing the saline to be used as proctoclysis, and gave the patient one and one-half liters of the solution in two doses, as was ordered. The poisoning which resulted from the nine ounces or more of salt, which he received, soon produced death of the patient. Campbell[15] reported a case in which a saline enema was advised, in a case of "worms." The patient, a boy five years old, received one pound of salt, instead of a tablespoonful, in a quart of water, as was advised. In five to ten minutes, the child complained of intense thirst and pains in the head. Vomiting occurred soon after this and was followed by purging. Within one and one-half hours he was unconscious, and died in convulsions five hours from the time he was given the enema by his mother. Evans cited a case of poisoning due to saline proctoclysis. This patient was operated upon for carcinoma of the uterus. "Normal saline solution" was ordered as continuous proctoclysis, and the nurse gave five quarts of this fluid within eight hours. The pulse rose suddenly to 148 per minute, became irregular and weak, and soon the patient became stuporous. By discontinuing the saline, and by using stimulants, the patient, fortunately, was revived. Sippel[16] reported a death from saline infusion in which three liters of a physiologic salt solution were given after decapsulating the kidney for anuria. The anuria was relieved by the operation, but quickly returned, following the saline infusion, and resulted in a fatal termination of a normally progressing surgical convalescence.

It is a well-known fact that sodium chloride, though the least toxic of the metal chlorides, is exceedingly poisonous, when given in large amounts. Joseph and Meltzer,[17] a number of years ago, showed that 3.7 grams per kilo of body weight, was sufficient to kill healthy animals. In Sippel's case 28 grams of sodium chloride were given, and in Brook's case 135. Normally, the body only excretes ten to fifteen grams and to add even more than this amount to the already overloaded kidneys, could hardly be expected to end otherwise than badly for the patient.

Trout[18] recently experimented with plain tap water, and physiologic salt solution per rectum. The salt solution contained .6% to .9% sodium chloride. In over two thousand cases, one hundred and twenty-one complained of thirst in spite of large amounts of fluid, which were given. Of these cases one hundred and twelve received the salt solution only, and in this number several complained of having salty taste in the mouth, though they did not know they were getting this mineral. He states he would no more consider giving salt water by rectum, than he would giving it by mouth, when the patient required fluid to quench his thirst. I heartily agree with Trout, and my cases never get salt solution as protoclysis. I give instead a solution containing glucose 3% and sodium bicarbonate 5% in tap water. I give large amounts in cases where it is needed, even surpassing nine quarts in twenty-four hours, as given at first by Murphy. The solution is kept going for a week at a time, night and day, in severely toxic or dried-out patients, especially when fluid can not be readily taken through the mouth. In my experience, this solution is more easily absorbed, less irritating, and altogether a better medium to decrease nausea and thirst, than saline. The tube being in place, allows escape of gas, and pains due to this are therefore less frequent where this measure is employed. The catheter causes very little discomfort, and in many cases its presence is not known.

Since Kausch's[19] article in 1911, glucose has been used extensively in surgical cases. It not only supplies energy to the cells, and aids in tissue repair, but also diminishes acidosis by giving carbohydrate food to the organism. It therefore greatly aids in preventing postoperative vomiting, and since it is very little irritating, if at all, to the mucous membrane of the bowel, we have employed it as a routine in our plain tap water. This substance is burned in the body, is not excreted in the urine, and serves as a food, giving 300 to 500 calories per day, to the average patient. This is not sufficient, however, to supply the total energy requirements of the body, but greatly aids in excessive nitrogen waste, and thus we get universally good results from its use. The use of sodium bicarbonate 5 per cent in the fluid given per rectum decreases the tendency to acidosis.

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CHAPTER LVI

HYPODERMOCLYSIS

By Willard Bartlett, St. Louis, Mo.

It will be readily admitted that a convalescent patient, like any other human being, has at least three vital necessities. He can survive but a very limited period without oxygen; life is possible for a considerably longer time without water, while the lack of food may be endured for quite an extended term. The first is, of course, a vital need; the second *becomes* one in a relatively short time, while the third will *ultimately* assert itself in much the same way. The first and third have been dealt with elsewhere, and this chapter concerns itself with what I believe to be the most practical and generally useful means of administering water to an individual who can not take it in the normal manner, and I am convinced that very many patients die at the present day because their output exceeds the intake which is possible, in the physiologic manner.

There is the greatest variety of conditions in which the swallowing of water and its absorption in the lower intestinal tract is interfered with. In surgery this derangement is noted most commonly following the action of some toxic substance like an anesthetic, or in consequence of an obstruction in the digestive tract, be this due either to a mechanical or to an inflammatory cause, or lastly, in individuals where we dare not start up peristalsis for the damage it is likely to do *per se*.

It must be borne in mind, as a fundamental principle underlying this study, that water is not absorbed from the walls of the stomach, or indeed, to any extent, until it has reached the colon; hence, one who thinks in terms of physiology readily grasps the fact that a patient who is vomiting receives no fluid into his circulatory apparatus, and therefore, profits not at all by any amount that is swallowed. Unfortunately, output and intake are not at a standstill in such instances, since many an individual who vomits copiously, really ejects more than he drinks, which is explained by a greatly augmented secretion of upper intestinal and stomach juices. As dehydration progresses, such patients complain more and more of an agonizing thirst, no matter how much water is swallowed.

In most instances where water can not be taken by the natural means, it is injected into the *rectum*, and although it may surprise the reader, he will find upon investigation, that by far the greater quantity of the fluid so administered, gradually finds its way into the bedding beneath the patient.

Until about one year previous to the time this is written, I, like others, in the habit of following the advice of well-known leaders of surgical thought, blindly ordered the drop by drop administration of water per anum, with great frequency. The year-long protests of patients who were subjected to this treatment, finally led me to take up the matter with many intelligent nurses, and I succeeded in eliciting the fact that a very small percentage of fluid, which is intended to reach the circulatory system in this way, ever really accomplishes this. At the same time, practically every patient is disturbed by this therapeutic maneuver, and worst of all, active peristalsis is started up, in patients suffering from peritonitis, just that type in which the intestines should remain at rest, and fluid be rapidly absorbed instead of thrown out by the activated hollow viscera.

A storm of protests has met the foregoing arguments, where presented to experienced surgeons, but I have yet to find that one of those to whom I have mentioned the subject, had given the matter personal attention, and still, I invite any man who is really interested in it to remain on duty with the nurse for an hour or two after the administration of the proctoclysis which he has ordered. If the patient remains undisturbed, and the fluid be definitely retained in any satisfactory percentage of the patients observed, I think he had better continue to use it.

This, however, has not been my experience, no matter what the technic employed; and I may adduce as the best proof of the correctness of my reasoning, that my results have by no means grown worse during the year that it has not been employed in one single instance.

Another way of introducing water into the circulatory apparatus, when swallowing can not be allowed, is that of McArthur, mentioned elsewhere in this book, who lets water flow into the *gall bladder* through the drainage tube commonly employed in that viscus. McArthur and Matas have accomplished wonders in this way, not only in the administration of water, but of fluid nourishment as well. There is no valid objection to this method in the comparatively rare instances where the gall bladder and cystic and common ducts are available for this purpose. However, it will be readily admitted that a comparatively small portion of our surgical work is done upon the biliary apparatus.

The *intravenous* infusion of salt solution or other physiologic fluids, has been employed with success. However, this is a distinctly dangerous method and is not to be used under ordinary circumstances. I can not go here into the intricate physiologic reasoning involved, but will content myself with mere mention of the fact that every surgeon of experience has seen a terrific chill, with attendant depression, follow the too rapid inflow of salt solution into a vein, if he has tried to introduce a reasonably large amount in this way. Nothing is easier to produce experimentally than an edema of the lungs, dilatation of the right heart, and a peritoneal accumulation so great as to interfere with the excursions of the diaphragm, by the overintroduction of saline into a vein. It goes then, without saying, that the method has obvious disadvantages, and is not to be employed as a routine procedure.

The *intraperitoneal* introduction of fluid is quite feasible, but is dangerous unless practiced with the greatest caution, for reasons that are apparent to any one. The likelihood of injuring an abdominal viscus, if the fluid is delivered through a trocar, is always present. One must not forget the danger of interfering seriously with respiration by too much fluid preventing the excursions of the diaphragm. This method is employed with success by certain skilled specialists in the treatment of infantile disorders. However, it seems quite reasonable to suppose that it can never occupy a prominent place in therapeutics, if it has to be used as a routine procedure by physicians at large.

After having condemned, or at least urged the inadequacy of the last mentioned four methods, it is only fair that I should propose a substitute for them, and it is, indeed, with no little degree of satisfaction that I advocate the following method of subcutaneous administration, which is original with Dr. McKittrick and myself, although, it must be stated in all fairness, that after we had used it for one year, Allen B. Kanavel of Chicago, who knew nothing of our work, was the first to give it the public notice it deserved.

The apparatus most commonly employed by us consists of a graduated 800 c.c. glass container (Fig. 191) which is connected by rubber tubing, one half inch in diameter, and four feet long, to a regular hypodermic needle (No. 18) three inches long, with 1/32

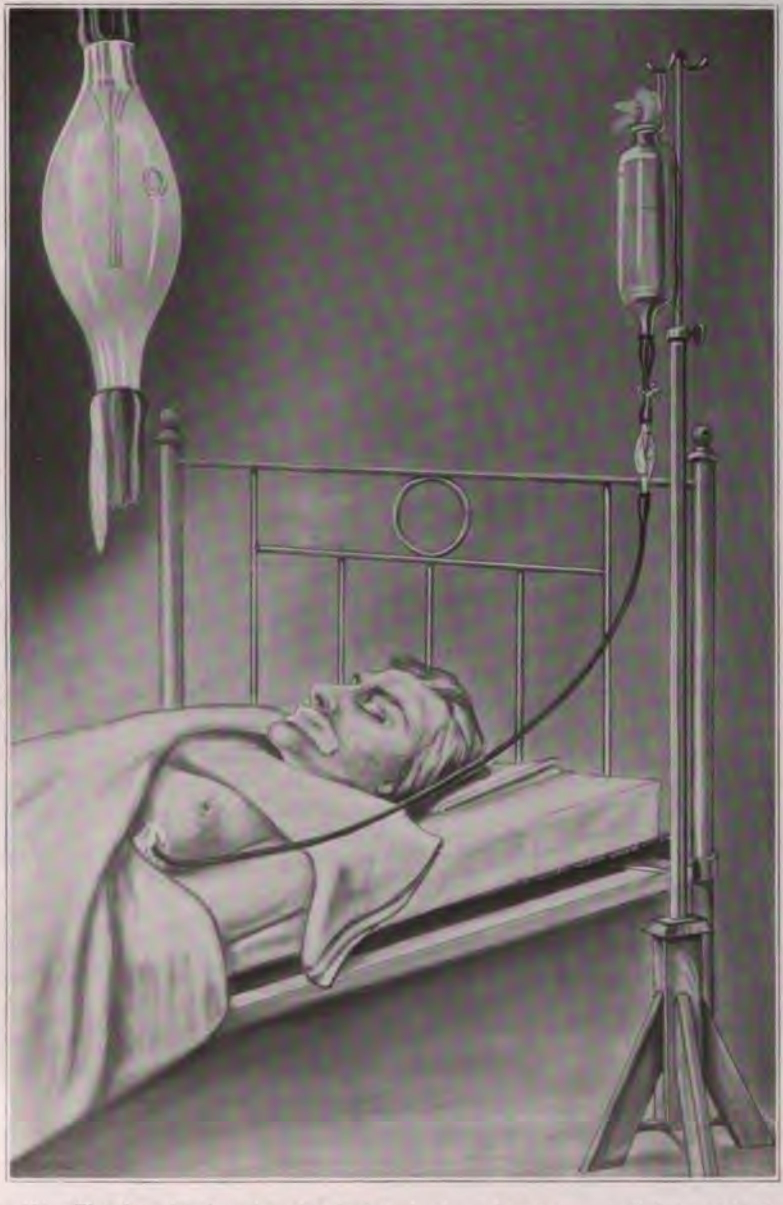


Fig. 191.—The drop by drop hypodermic introduction of water, controlled by sight feed.

inch bore. When continuous hypodermoclysis is used, the visible dropper and screw clamp, as is used in the proctoclysis outfit, and also a clamp, as is seen ordinarily with regular fountain syringes, is added.

An attempt is made to get gravity pressure by placing the container directly above the patient. This maneuver must take all the kinks out of the tube, and thereby encourage the proper flow of the stream.

As to the fluid employed, Dr. McKittrick proposed that we use plain, freshly distilled sterile water. In view of the large amounts of fluid instilled, and the harmful effects which occasionally follow the absorption of abnormal amounts of sodium chloride, we do not countenance its use, especially in patients already weakened by disease, or surgical trauma. The water is heated to between 100° to 110° F. and then poured into the warm container, which is supported on an adjustable pole. The slender needle is first thrust through the center of a square fold of gauze (Fig. 192) (25 mesh to the inch, and 6 ply thick), and is now ready for use. This prevents the hand touching the needle or contaminating the skin, which has been cleaned with alcohol, and painted with iodine diluted ⅓ its strength with alcohol. The fluid is now started through the tubing, and when all air has thereby been expelled, the tubing is temporarily pinched off with the thumb and finger, and the operation begins.

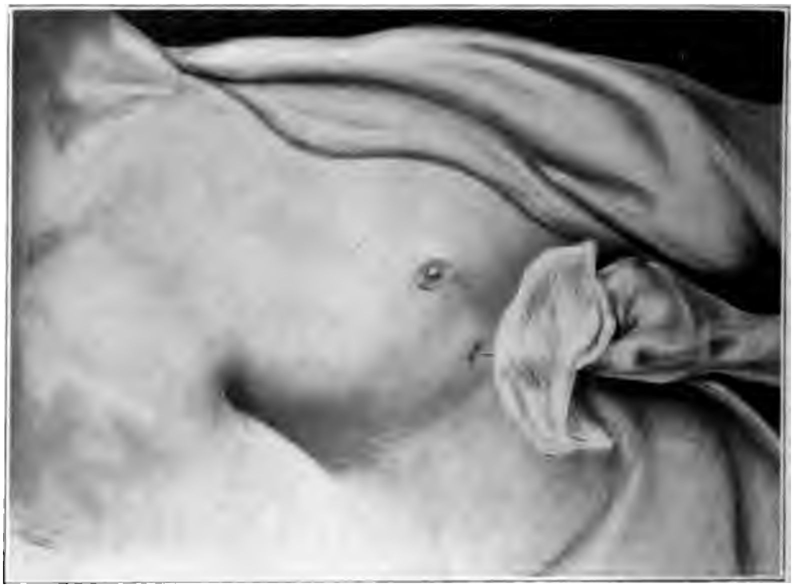


Fig. 192.- The needle introduced through a square of gauze.

In unconscious patients, the needle (Fig. 193) is plunged up to its flange in the subcutaneous tissue, at a point near the outer border of the pectoral muscles, midway between the nipple and the head of the humerus. By this method, the fluid extends directly into the subcutaneous tissue of both the axilla and the breast. Absorption is almost twice as fast as it is when the injection is under the breast alone. The needle is held in place by a strip of adhesive, (Fig. 193) the original piece of gauze being utilized to prevent contamination of the needle wound. If the needle remains in very long, alcohol is dropped over this region from time to time, and gauze is then placed over the exposed portion of the needle, adhesive and all. A hot water bag, wrapped with a towel, is placed directly under the axilla, and another one over the gauze, which protects the needle. Massage is not attempted, except that occasionally one exerts firm rotary pressure over some slowly hardening area. The fluid should not run in so fast, but what, with the aid of the hot water bottles, the tissues, though very slightly edematous, remain soft and pliable. Only the one side is used at a time regardless of the amount of fluid to be infused. Usually 1000 c.c. is given during one injection, though a much larger amount can be given if it is allowed to run in slowly. Between one and two hours is all

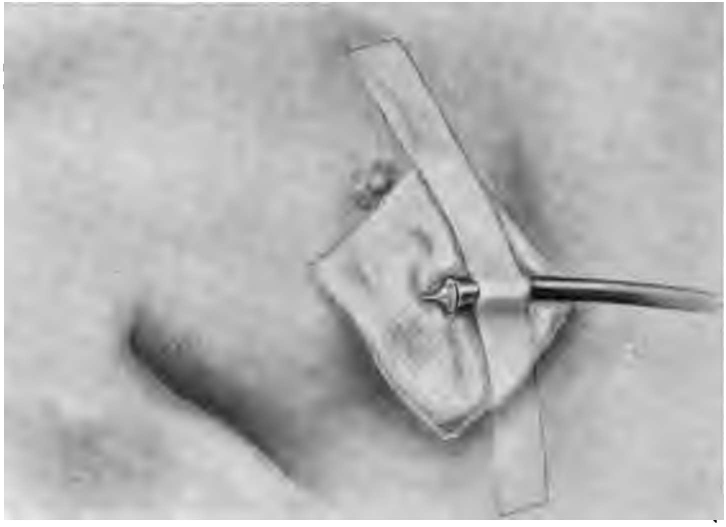


Fig. 193.—Needle and gauze held in place by adhesive.

the time needed in the ordinary case, and frequently one hour sufficient, this differing with individuals.

Multiple needles, although employed by some, simply add to th individual's discomfort by multiplying the sources of it. And n only this, but they seem to me to violate the most important prin ciple here under discussion, viz., that they may deliver the flui with such rapidity as to incite the only serious danger possibl here, that of circulatory plethora, followed by acute dilatation o the right heart, and first made evident by edema of the lungs.

In giving large amounts of water, the heart and lungs are care fully studied, and the blood pressure taken occasionally. If dangerous degree of plethora is produced the heart beat corre spondingly increases in rate and force, and finally the heart dilates Then the blood pressure falls. Other less ominous signs are swell ing of the eyelids, face, hands, and feet.

The giving of hypodermoclysis is easily accomplished withou pain or distress in most patients not under the influence of narcotic. There is a type of oversensitive individual in whom more than this is necessary. In such instances a very fine hypodermic needle is used to anesthetize the skin, with one-half per cen novocaine. The skin is then punctured, and the solution carried along the route which the hypodermoclysis needle will follow. This is inserted as soon as the patient is unable to feel any pain. The clamp is now gradually released, so as to permit the water t enter slowly, and diffuse the anesthetic ahead of it. After a few minutes the patient will experience a little pain from the pressure of the water. The tube is then clamped off, and a small quantity of ½ per cent novocaine injected into it under pressure, by mean of a 10 c.c. syringe (Fig. 194). The pain having ceased, the wate is again turned on, and the patient can take a few hundred more c.c. when further injection of novocaine may be made. If more than one reservoir full is required, more water is poured into the reservoir and the injection of novocaine repeated as often as the patient complains of pain. This will not occur more than once or twice during the hour.

In patients who may be relied upon to let the needle alone *continuous* hypodermoclysis may be employed. In this case, by means of a dropper and screw clamp, the water is given in drops while the rate of flow varies with the rate of absorption. The tissues are not allowed to become swollen. The patient will usually take 40 to 80 drops to the minute without this occurring. Such a method is indeed desirable, one which permits fluid to enter the tissues to the extent that pain is caused. If this occurs, the patient, (if he is one to be trusted) may stop the flow by means of an ordinary syringe clamp, supplied for this purpose, and when the pain ceases, he can start the solution by releasing his clamp. When the hypodermoclysis operation is finished, the needle wound is cleansed with alcohol, and then closed by means of adhesive or a

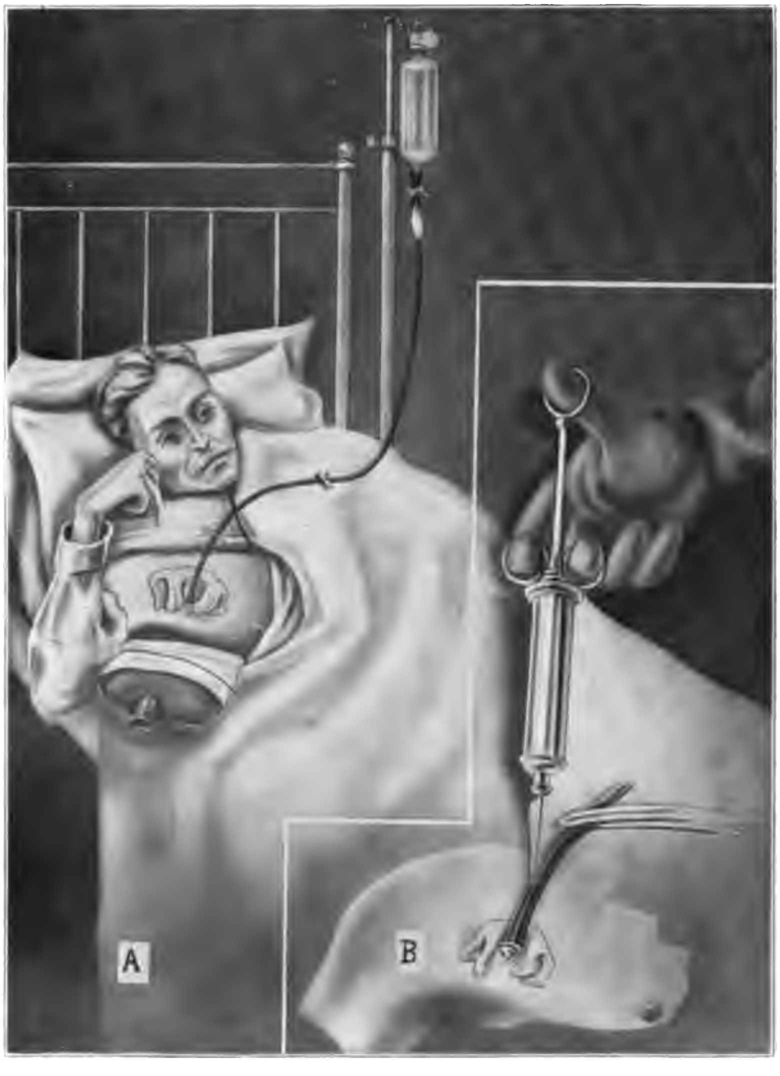


Fig. [illegible]. *A.* A hot water bottle in position. *B.* Novocaine introduced repeatedly during the operation.

little cotton and collodion. Heat is continuously applied until traces of the fluid have disappeared, and the soreness gone.

We have given fluid by this method for a period of several da In one case, McKittrick gave 10,000 c.c. in less than three day on numerous other occasions, we have employed large amoun with good results.

We have never seen a patient show evidences of having receiv too much fluid, nor incurred any harmful results from the use of th method; we have on the other hand observed time and again, p tients who seemed in the utmost extremity of dehydration co patible with life, make a most satisfactory convalescence when was used.

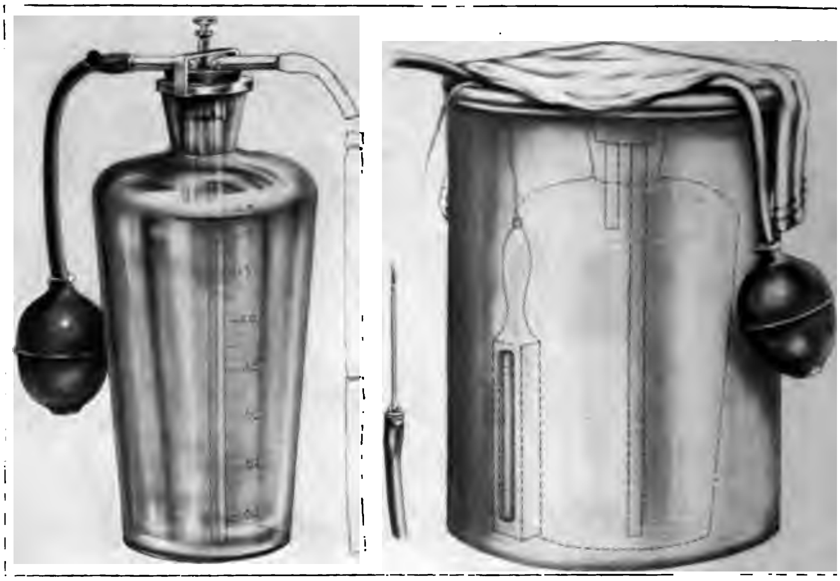


Fig. 195. Fig. 196.

Figs. 195 and 196. -An apparatus for maintaining the temperature of a fluid to be intro duced under the skin, used at Mayo Clinic.

McKittrick, as far as the writer knows, is the pioneer in the use of plain distilled sterile water in continuous hypodermoclysis Kanavel used the continuous method, but physiologic saline solution was introduced instead. We have seen no ill effects from the water infusions, either in the skin or subcutaneous tissues, and the absorption seemed much quicker than with the saline solution In testing out this point, McKittrick injected 1600 c.c. of plai water into one axilla of a patient, and saline into the other at the same time. The plain water disappeared from the reservoir thirty minutes to one hour the sooner, and the tissues next day were normal, so far as physical examination was possible, while those in which the salt solution was injected, were the seat of soreness, and considerable crepitus was present.

As is perfectly well known to physicians, the blood pressure can not be raised above normal by the infusion of fluid into the veins, no matter what quantity be employed. Any attempt in this direction simply causes extravasation.

McKittrick believes on the other hand, that the subcutaneous infusion of distilled water has lowered unnecessarily high blood pressures in the cases of which he has kept blood pressure records. He goes so far as to conclude that he has seen unduly high arterial tension in chronic interstitial nephritis rendered lower in this manner.

We must state in conclusion, that the procedure has completely supplanted the rectal administration in my service, and where intelligently applied, seems not to have unduly disturbed the patient, has never been attended by an accident, and has given the greatest satisfaction.

CHAPTER LVII

BLOOD TRANSFUSION

By Willard Bartlett, St. Louis, Mo.

We can imagine no more striking introduction to this subje than the words of McClure and Dunn,[1] which we present verbatim "From the very earliest times, the blood has been regarded a synonymous with life. It was considered by the ancients as th seat of the soul. In the Bible we have the following: 'Becaus the life of the flesh is in the blood and I have given it to you upo the altar to make an atonement for your souls: for it is the bloo that maketh an atonement for the soul.' Many references are mad to transfusion of blood in the writings of the ancient Egyptians It was condemned by Pliny and Celsus. In the Metamorphoses o Ovid we have: '*Quid nunc dubitatis inertes? Stringite, ait, gladios, veteremque haurite cruorem, ut repleam vacuas juvenili sanguin venas.*' 'Why, now, do ye hesitate and do nothing? Unsheathe your swords and draw out the old blood, that I may fill the empty veins with the blood of the youth.' Libavius in 1615 reports in '*De-fensione Syntagmatis arcanorum chymicorum*' as follows: 'Let there be present a robust, healthy youth full of lively blood. Let there come one exhausted in strength, weak, enervated, scarcely breathing. Let the master of the art (the operator) have silver tubes that can be adapted one to the other; then let him open an artery of the healthy one, insert the tube, and secure it. Next let him incise the artery of the patient and put into it the feminine (receiving) tube. Now let him adapt the two tubes to each other and the arterial blood of the healthy one, warm and full of spirit, will leap into the (vessels of the) sick one, and immediately will bring to him the fountain of life and will drive away all languor.' "

However, the first authentic record[2] we have is that of Pope Innocent VIII, who was transfused by his Jewish physician in 1492, three little boys being used as donors; this doctor, whose name has been lost to science, failed to benefit his patient. No other attempts were made to perfect the procedure further than discussion of it, until Harvey's discovery of the circulation, when new interest was manifested and research work was done upon animals, but it was not before the middle of the 17th century that it was recognized as a surgical procedure.[2] During the year 1666, in France, Lower first gave a method in detail, and Denny's experimenting along the same lines, successfully transfused three human beings. Following their work, many instances of transfusion were reported, sometimes from animal to man, and at times from man to man. The vessels were connected end to end or by means of a quill or cannula of silver or of bone, or indirectly by a pump or syringe. Several successful attempts were reported, but such fierce opposition was aroused that in 1668, the method was forbidden except by special permit of the Faculté of Paris.[3]

This naturally had a disquieting effect, and except for a discussion now and then, the method fell into disuse and was not revived until the 19th century. At this time, Blundell[4] in England did further experimental work helping to more firmly establish this procedure as an important step in experimental physiology. Work continued uninterruptedly, and by the middle of the century (1863), Blasius had collected 116 cases of transfusion, performed during the preceding forty years, and found 56 successful results. In two cases alone, the serum was from animals, and in all cases the indirect method was used.

Men became highly enthusiastic, great claims were advanced for transfusion and many operative methods were devised, but it soon became apparent that these claims were unfounded after Landois discovered that heterogeneous blood could not be used because of red blood corpuscular destruction, and Blasius' defibrinated blood was found dangerous because its fibrin ferment caused coagulation. The general introduction of normal salt solution, about 1875, brought about a gradual decline in the transfusion of blood until 1880, when it was again revived and followed with vigor until today.

I had the good fortune recently, to learn through personal communication, the details of the first transfusions done in America by Dr. W. S. Halsted. He had several patients suffering from carbon monoxide poisoning, whom he treated by withdrawing blood, defibrinating the same and re-fusing it into the same individual. These were all arterial in nature, the blood being returned in the centripetal direction.

We shall now turn from the historical aspect of our subject, in an effort to study the individual who is best suited to act as a *donor.* It is of such importance to select the right person that in our largest clinics these people are hired and kept ready to meet any emergency.[5] A Wassermann reaction must be made on them, as in the case of *every other donor.*

Lewisohn reminds us that "the following important facts ought to be kept in mind in connection with this question: 1. Donors can not be used a second time for the same patient without another test as to hemolysis and agglutination. 2. Blood relatives (parents and children, brothers, etc.) have to be tested just as thoroughly as strangers, as their blood often is very incompatible in spite of their near blood relationship. Cherry and Langrock have asserted that in newborn infants the mother's blood can always be used with perfect safety for a transfusion. Other workers, however, do not agree with this statement."

These donors are selected by the method of Moss,[6] which is based on the principle that before the serum of one blood will cause an hemolysis of the corpuscles of another, it will first or simultaneously cause an agglutination of the corpuscles. The reverse, that all cases which show agglutination will also show hemolysis, is not necessarily true, occurring in only about 20 per cent of cases. Adopting this principle, all bloods are classified according to the agglutinative properties of their elements, into one of four groups. In selecting the donor then, it is advisable to have one whose blood belongs to the same group as that of the patient. If this is impossible, the donor's blood should belong to a group whose corpuscles are not agglutinated by the serum of the patient.

Group I.—Serum does not agglutinate corpuscles of any group. Its corpuscles are agglutinated by serum of II, III and IV.

Group II.—Serum agglutinates corpuscles of Groups I and II, but not IV. Corpuscles are agglutinated by serum of Groups III and IV, but not I.

Group III.—Serum agglutinates corpuscles of Groups I and II, but not IV. Corpuscles agglutinated by serum of Groups II and IV, but not I.

Group IV.—Serum agglutinates corpuscles of Groups I, II, and III. Corpuscles are not agglutinated by any serum.

Seven per cent of all donors belong to Group I; 40 per cent to Group II; 10 per cent to Group III; and 43 per cent to Group IV.

The serum of one group will not agglutinate the corpuscles of blood belonging to the same group.

In grouping the bloods, the unknown blood should be tested with a blood whose group is known. This "standard" blood must belong to either Group II or III in order to be of value in grouping other blood. The group to which a blood belongs remains constant. It is not influenced by age, disease or transfusion of blood belonging to another group.

Technic.—A puncture wound is made in the finger and eight to ten drops of blood are allowed to flow into a small, clean, dry test tube. From five to eight drops are allowed to flow into a second tube that contains 2 to 3 c.c. of 1½ per cent sodium citrate solution. These tubes are centrifuged for five minutes. The fibrin and blood cells in the first tube will have clotted and settled to the bottom, allowing the clear serum to remain on top. The corpuscles of the second tube will have settled at the bottom. The supernatant fluid in this tube is carefully withdrawn and 2 to 3 c.c. salt solution are added to the corpuscles to wash them. This tube is again centrifuged for 3-5 minutes. The supernatant fluid is withdrawn by a pipette and a 5 per cent suspension of the corpuscles in normal salt solution is made. The standard blood of the known group is prepared in the same manner. Then using a platinum loop, a loopful of the 5 per cent suspension of corpuscles from the blood to be grouped, (blood A) is placed on a clean cover-glass. Two loopfuls of serum of the standard of known blood (B) are placed on the same cover-glass. To prevent a possible masking of agglutination by an accompanying hemolysis which occasionally takes place, a loopful of serum of blood A is also placed on the cover-glass and all carefully mixed, and the cover-glass is placed on a hanging glass slide. If there is to be any agglutination, the clumping of the cells can be seen under the microscope in from one to three minutes. Macroscopically, if there is agglutination, a brick-dust sediment will be seen in the drop. A second drop is made by using one loopful of 5 per cent suspension of corpuscles from blood B, one loopful of serum B, and two loopfuls of serum of blood A. The results of these drops are noted and then compared with the chart of groups.

By using this method, blood can be grouped in from 30 to 40 minutes, and after a patient is once grouped, he does not have to be subsequently inconvenienced by having his blood reexamined if a second donor is to be used.

Minot[7] states that hemolysis will not occur always even if the donor and recipient do not belong to the same iso-agglutination group, since only 20 per cent of sera that are agglutinate are hemolytic. Hemolysis never occurs without agglutination.

Lindeman[8] has found that the preliminary blood tests for hemolysis and agglutination as done by various serologists do not always agree, and therefore are not reliable, so he examines the blood himself, the technic being as follows: The red blood cells of the patient and donor are washed three times with normal saline; variable quantities of patient's serum are placed in three separa small test tubes; to each of these is added 0.25 c.c. of a 2 per ce suspension of washed blood cells of the donor. The same is do with the donor's serum and the patient's cells. Controls are ma of donor's serum and donor's cells, patient's serum and patient cells. Controls are also made with donor's cells in normal sa solution and patient's cells in normal salt solution. The tot volume in each tube is raised with normal saline to 0.5 c.c. c volume. The test tubes are incubated in a water-bath for a perio of two hours, and readings are made. They are then set into th ice box overnight and readings are again taken the following morning. When a case is urgent, the ice box test is eliminated.

Since Lindeman has applied his technic of testing donors, his las 155 transfusions by the syringe cannula system have been performed without the loss of a single case by death. Chills followe by a rise in temperature occurred in 16 instances. He has foun that hemolysis never occurs without chills and fever unless the patient dies during or shortly after the transfusion. He infers therefore that chills and fever in transfusion are due to hemoglobi set free in the circulating blood. If the hemoglobin set free i abundant, it appears in the urine; when the amount is moderat hematoporphyrin appears in the urine. It would appear to him tha four conclusions as to incompatability are warranted.

1. The preliminary hemolytic and agglutination tests whe properly performed are reliable.

2. Incidents of hemolysis in transfusion can be eliminated entirely.

3. The reactions which follow transfusion when accurate tests have been made are eliminated in all except 9 per cent of the cases. In this 9 per cent, chills and fever alone occur. When the quantity is 800 c.c. or less, chills and fever do not occur.

4. By careful, accurate, and complete hemolysis and agglutinin tests, granted that work is done skillfully, blood transfusion is robbed of all danger attending its use.

Ottenberg and Kaliski estimated that there are toxic reactions, not referable to agglutination or hemolysis, in 10 per cent of all cases, as based on their own series of 128 cases.

Ottenberg and Libman[9] in their series of 212 cases of transfusions, in summarizing the untoward results due to transfusions, assign the most unfavorable reactions of their series, including 5 deaths, to "incompatible blood" (meaning hemolysis or agglutination only) or to hypertransfusion. They state fever appeared in 10 per cent of all cases, skin eruptions, usually urticarial, occasionally petechial, appeared in another 10 per cent. In referring to the hemolytic and agglutination reactions as being an insufficient guide to the value of a given donor's blood for the purpose of stimulating a remission of the disease in pernicious anemia, they make the statement that "there are probably other not yet recognized differences between the bloods of donors."

Lewisohn[10] reports 5 febrile reactions and 3 chills in 22 transfusions.

Two cases with favorable agglutination and hemolysis tests, in which there were toxic reactions, are reported by Cooke in a series of 12 transfusions.

Those with experience in blood transfusions have observed certain toxic symptoms varying all the way from a slight chill and rise in temperature to marked anaphylactoid phenomena, and even death has occasionally resulted as the immediate sequela to transfusion even where the serologic tests for hemolysis and agglutination have been entirely favorable. To explain this the three following hypotheses have been suggested by Pemberton:

1. It is possible that trypsin-antitrypsin balance in the circulating blood of the recipient may be so disturbed by the commingling with the donor's blood as to result in the immediate formation of serotoxin from cleavage of serum protein.

2. It is possible that the action of the protective colloids in the body cells of the recipient may be so disturbed that these cells are thereby exposed to a reaction of antigen and antibody present in the circulation of the recipient but harmless to the protected cell.

3. There is the possibility of a toxic disturbance in the circulation of the recipient by the introduction of blood which, though perfectly fluid, may nevertheless be undergoing incipient coagulative changes due to physical influences to which it is subjected in process of transfer.

Now, having read the laboratory side of this important borderline subject, let us note the opinions of three experienced surgeons on it.

Deaver[11] claims that too much mystery has surrounded blood transfusion and that most of the instruments for its performance are too complicated, and therefore can be of little use to the surgeon. He points out that in 25 per cent of all cases transfused, hemolysis occurs. Too much attention can not be given the donors. The methods of Crile, Brewer, McGrath and others are criticized because amount of blood transfused can not be measured, and while Deaver does not believe it necessary to be absolutely exact, he thinks it is best to keep within the limits of safety, for some cases require only small amounts. He employs the spurt method to determine the amount of blood used, the radial artery being selected because of the driving force of the heart. The blood is allowed to spurt into a small graduate; if it takes 5 spurts to reach the dram mark, each spurt will contain 12 drops, and a pulse of 80 will therefore discharge 2 ounces in one minute. This is considered as accurate as it is simple.

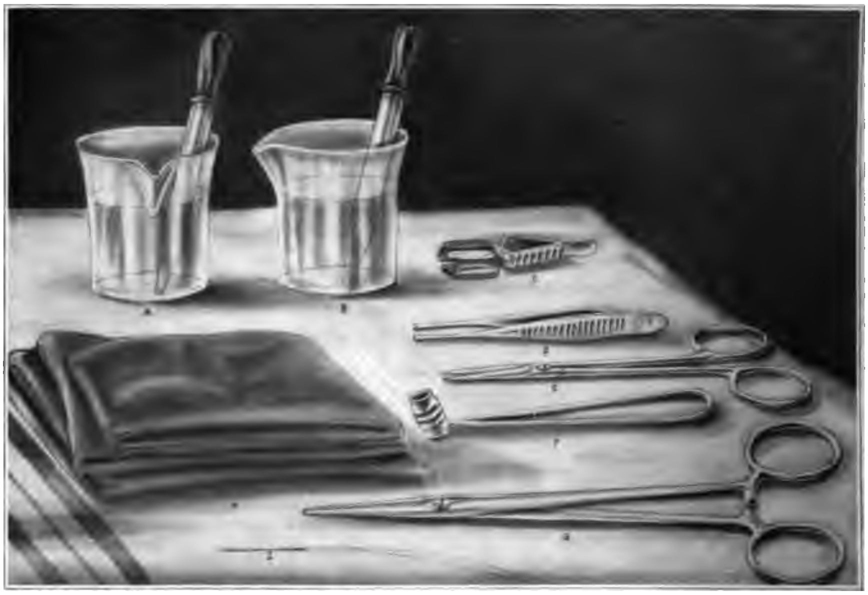


Fig. 197.—Instruments and material used in direct blood transfusion.

The authors have had no experience with this and therefore do not endorse it, as interesting as it sounds.

Percy[12] finds that the tests for hemolysis and agglutination *in vitro* as described by Rous and Turner, are not dependable, and he gives a preliminary transfusion of 20 c.c. of blood intravenously by hypodermic syringe, believing that this amount of blood will indicate hemolytic phenomena without serious sequelæ, or the full expression of the cardinal signs of fatal hemolysis which are: vomiting, respiratory distress, pain low in the back, a characteristic flush and profuse sweating followed by pronounced chills and suppression of urine.

Blood transfusion is in reality a homologous transplant of living tissue, the tissue being a complex fluid which possesses the ability to coagulate under certain conditions.[13] According to Hartwell, who bases his opinion upon a study of the recent literature, a small dose may produce the same effect as a massive one by chemical reaction. The only condition in which a massive transfusion of whole blood seems indicated is after a loss, from direct hemorrhage, of such severity that life is endangered because of insufficient blood to maintain oxygenation. There can be no argument against blood transfusion, properly performed, in cases of *acute hemorrhage*, the object being to replace the blood which is lost. The red cells, while quickly destroyed, serve as oxygen carriers and may tide over an emergency until the bone marrow can replace the lost cells.

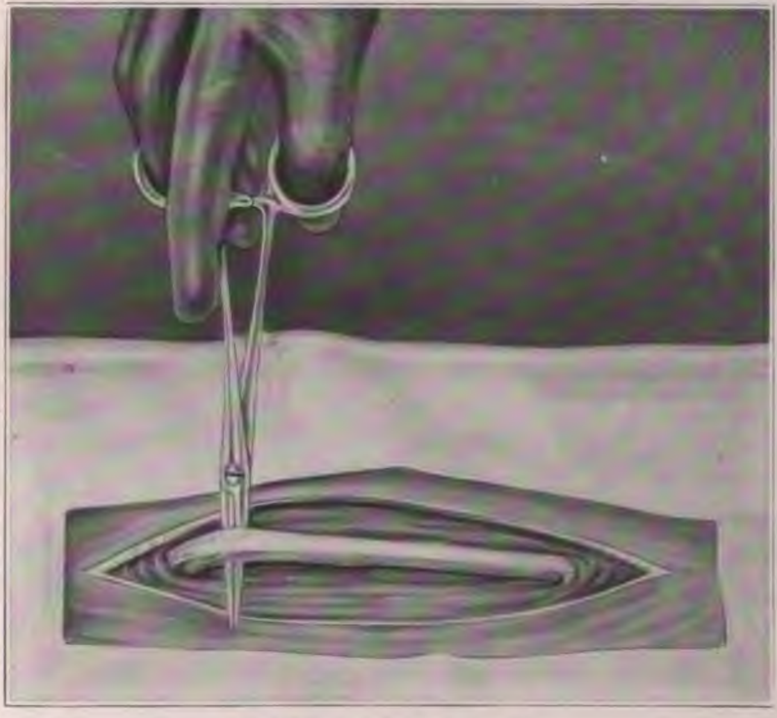


Fig. 198.—Dissecting out the vein.

The *indications* for blood transfusion in addition to the above are as follows:[14]

1. Marked secondary anemias, either as a palliative, or as a preoperative measure.

2. Essential anemias.
3. Blood dyscrasias, if fresh human serum[23] injections or thrombin are ineffective.
4. Disorders in the process of coagulation with increased susceptibility to hemorrhage.
5. Deficiency of the respiratory elements sufficient in degree to impair the integrity of vital organs.
6. Chronic localized infections of known etiology amenable to treatment, immunized blood should be used in such cases.

The ideal *technic* for transfusion involves four factors: absolute asepsis; no blood change; ability to measure the quantity transfused; and ease of accomplishment for donor, recipient and operator. Of the three methods in vogue, the direct intima to intima suture method, popularized by Carrell, and the intima to intima cannula method of Payr, Sweet and Crile (Figs. 197 to 204), are difficult procedures and no measure of the amount transfused can be recorded. The second direct method, the employment of a paraffin-coated tube as a connecting link between donor and recipient, is also far from ideal, as no quantitative estimation is possible and the danger of clotting is always present. In both of these, the re-

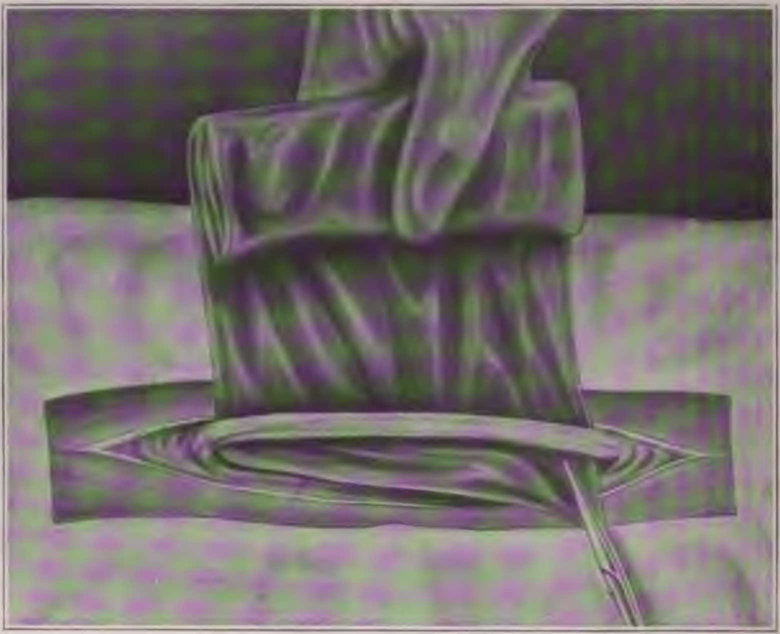


Fig. 199.—Placing the waxed black silk cloth under the vein.

cipient may infect the donor, while there is a real psychic danger to both individuals as a result of coupling them together.

The third and best method is an indirect one employing an intermediate receptacle, either making the transfer so rapidly that the blood has been drawn and discharged into the recipient's vein in less than normal coagulation time, or by the simpler plan of adopting means to delay or prevent coagulation.

The indirect methods possessing a clinical value are of three general forms: (1) Those employing syringes. (2) Those employing anticoagulates. (3) And those employing receptacles of which the Kimpton-Brown serves as a type.

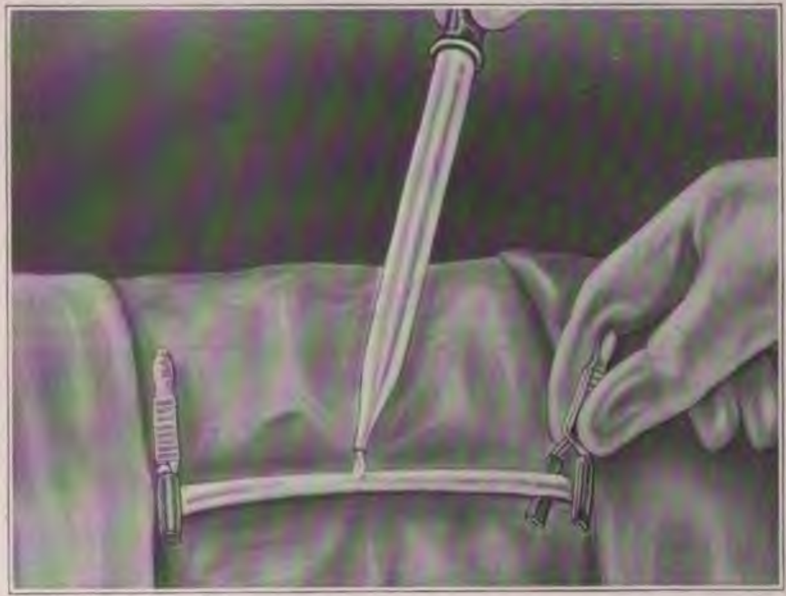


Fig. 200.—Placing bull dog clamps and oiling vein with a lubricant.

A good syringe method was described by Lindeman,[15] whose technic is as follows: Specially devised cannulas are painlessly inserted into the veins of the donor and patient without the skin incision if possible. About 15 syringes are used. No syringe is used a second time until thoroughly cleaned. One operator manages the syringe of the donor and another that of the patient. One syringe is being filled while the other is emptied. A little salt solution is allowed to trickle through the cannulas every now and then to prevent the possibility of any coagulation in them. It requires from six to twelve seconds to fill and empty a syringe. The largest quantity of blood he has taken from one donor in one sitting is 1500 c.c.; the time required was fifteen minutes; 30 c.c. salt solution was used. Since the coagulation time of blood drawn into a syringe is never less than five minutes, and in this method the blood is no longer in the syringe than twelve seconds, coagulation is almost out of the question. Adults received from 1000 to 1800 c.c. in each transfusion, and the quantity stated was always taken from one donor. No foreign substance or anticoagulant was employed in any case. By this technic the entire mass of blood is outside the body only for a period of from six to twelve seconds, regardless of the amount transferred. It passes through a minimum amount of foreign material.

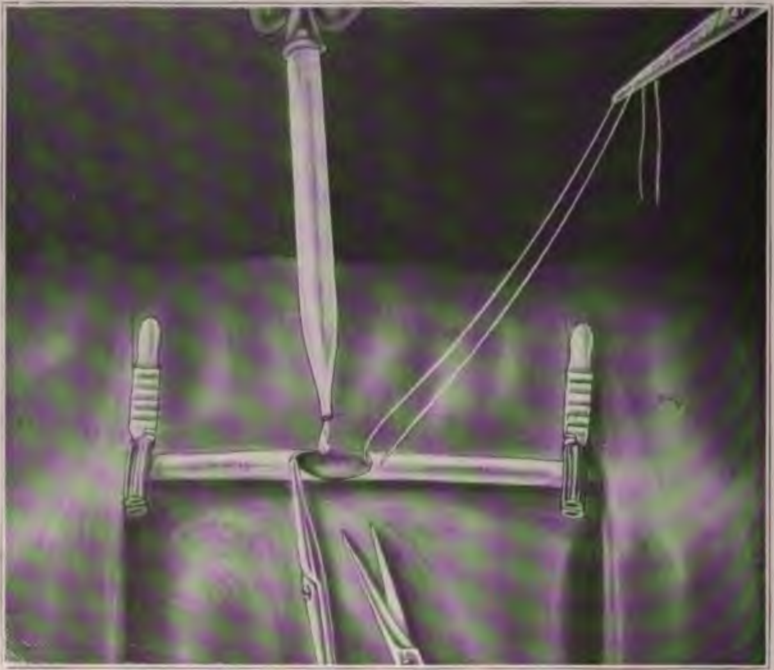


Fig. 201.—Vein cut in two, thread put through at one end, hemostat at other. Washing out vein with saline.

Miller[16], in the hope of finding a method of performing blood transfusion which would overcome all objections to the multiple syringe method of Lindeman, devised a valve, which consists of a central body, a cylinder 1.5 inches long and 0.5 inches in diameter, with two arms extending in opposite directions. From the middle of the central body projects a cylindrical stem just large enough

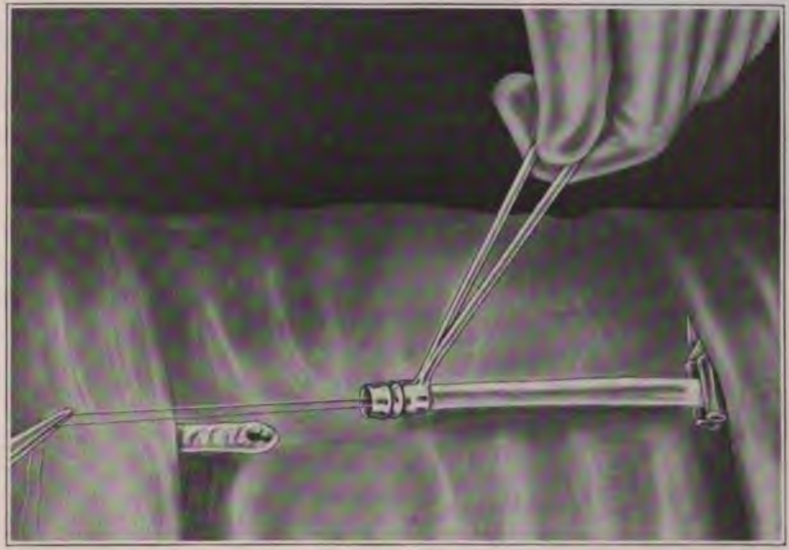


Fig. 202.—Drawing donor's vein through cannula.

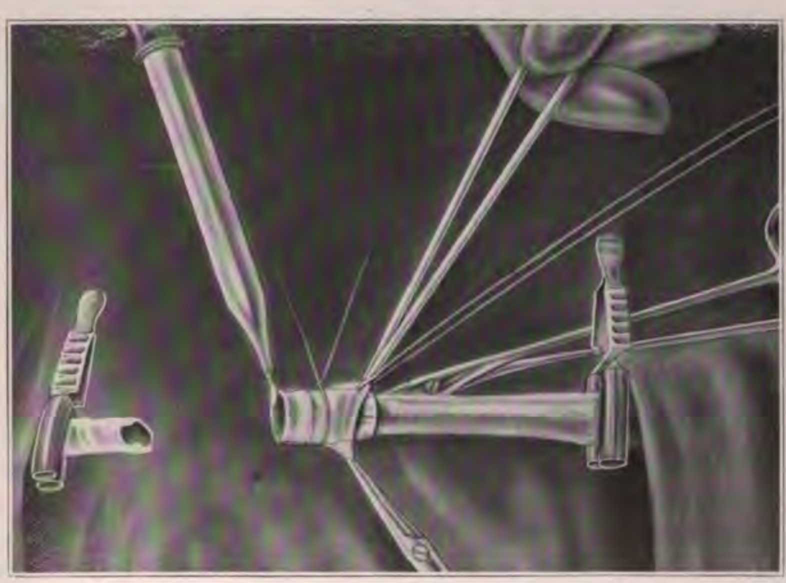


Fig. 203.—Vein drawn back and tied at second notch on cannula. Oil dropped into vein to prevent drying of surface.

to receive the tip of a record syringe. The two arms are connected to pieces of 12F. rubber tubing, three inches long. In the distal end of each tube a metal tube is inserted, which fits two cannulas and needles used for donor and recipient. By moving a thumbscrew back and forth, the current can be directed into either arm. By withdrawing the piston, the syringe is filled with blood, the thumbscrew is changed toward the recipient's arm and the syringe emptied rapidly. The operator continues to alternate the direction of the thumbscrew, filling and emptying the syringe, without disconnecting it from the valve, until the desired amount of blood has been transfused.

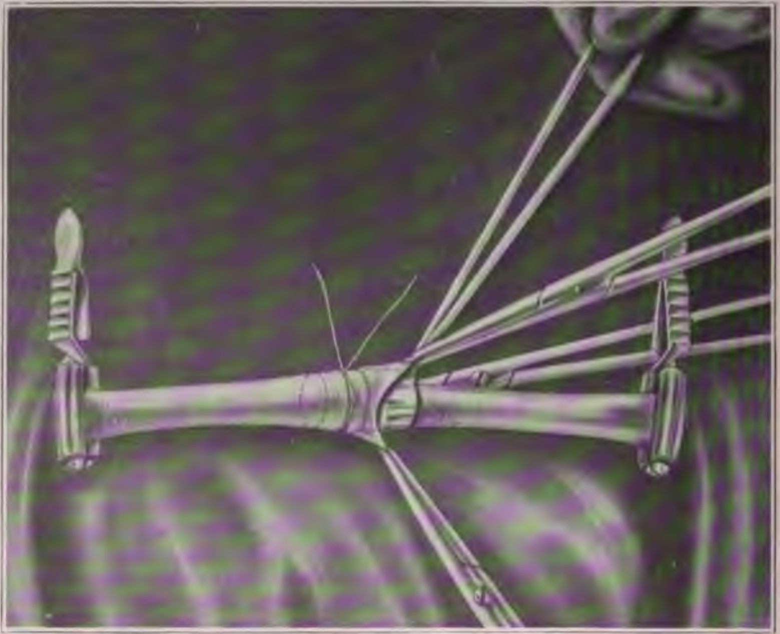


Fig. 204.—Placing and tying recipient's vein over cannula.

Lewisohn's[10] work was begun with the idea of simplifying the technic of blood transfusion. The object of this work was to find an atoxic anticoagulant which would prevent the blood from clotting during the transfer from donor to recipient.

From a series of animal experiments the following facts were elucidated:

1. Sodium citrate mixed with blood in the ratio of 0.2 per cent will prevent the blood from clotting for two to three days.
2. The coagulation time of the recipient's blood tested after the

transfusion of citrated blood, is shortened, but after a few hours the coagulation time again becomes normal.

3. Sodium citrate is only conditionally atoxic. Animal experiments show that if 1 per cent instead of 0.2 per cent citrate is present in the blood, transfusions of large amounts of citrated blood are fatal.

The author gives detailed reports of 22 blood transfusions performed by this method. The largest amount transfused at one time was 1000 c.c. In one case, 1600 c.c. were given to a patient within 24 hours. No untoward symptoms occurred in any of the cases. Some showed a moderate polyuria, caused by the introduction of the citrate. There were no macroscopic or microscopic changes in the urine.

Hemoglobin tests taken a few days after the transfusion show that the citrated blood is clinically as valuable as unmixed blood. Even hemorrhagic conditions are no contraindication against the use of this method, as the coagulation time of the recipient's blood is shortened after the transfusion of citrated blood.

The new method offers the following advantages as compared with the older:

1. The citrate method is technically as easy as an ordinary saline infusion, therefore, it does not require any special skill.

2. The donor and recipient are not in the same room, which lessens the psychic shock for the patient. Furthermore, it eliminates the risk of infecting the donor in cases of sepsis.

Perhaps no one is more adept at carrying out the citrate transfusion than J. de J. Pemberton of Rochester, hence, I give in extenso, his technic as related at the 1916 meeting of the Minnesota State Medical Society.

"Since December, 1915, we have been using the citrate method almost exclusively and in this series we have employed it in 217 cases. The criticisms of the method such as the resulting polyuria, the crenation of the red corpuscles, the idiosyncrasies to citrate, the exposure of the blood to air and contamination, are all unsubstantiated in the clinical application of the method. In no patient have we seen following the transfusion any untoward effect which could be attributed to the toxicity of the drug. The simplicity and sureness of technic, the safety of its employment and the proved therapeutic value of the citrated blood should recommend the method for a more extensive adoption.

"The arm of the donor is prepared in the usual manner, a tourniquet is lightly applied above the elbow and the vein (medium cephalic or medium basilic) is either punctured with a large-sized needle or exposed by a small incision and a cannula introduced (Fig. 205). By a simple yet very ingenious little trick advised by Watson, we have been aided greatly in introducing a large-sized Kaliski (gauge 11) needle (Figs. 206 and 207) into the lumen of the vein. By means of a small straight intestinal needle inserted transversely, the vein is transfixed to the skin, the needle passing through its upper segment (Fig. 208). With the end of this transfixing needle as a handle, the vein is then steadied and the can-

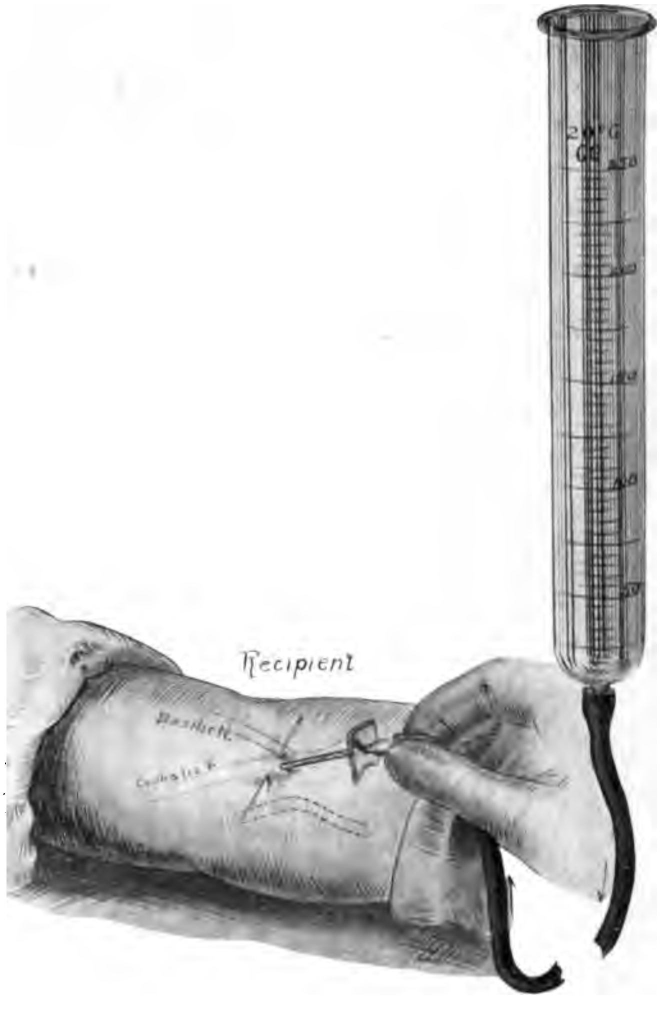


Fig. 205. Citrate transfusion as done by Pemberton.

nula needle, directed parallel with the line of the vein, can be readily pushed beneath the level of the transfixing needle into the lumen of the vein (illustration). The blood is received in a sterile graduated glass jar containing 30 cubic centimeters of a 2 per cent

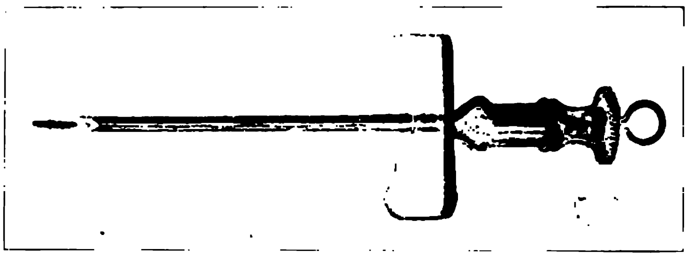


Fig. 206. The Kaliski needle.

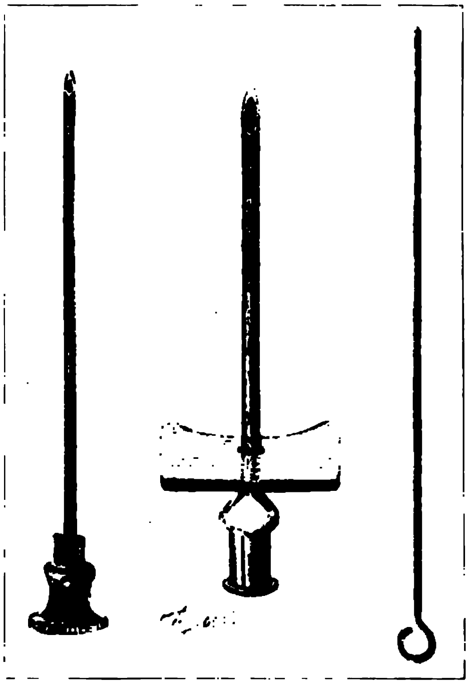


Fig. 207. The Kaliski needle separated into its component parts.

sterile solution of sodium citrate at the bottom (Fig. 209). While the blood is running it is well mixed with the citrate solution by means of a glass rod. After the blood has reached the 250 cubic centimeter mark, another 30 cubic centimeters of the citrate solution is added and the blood permitted to flow until there are 500 cubic centimeters of the mixture. If more blood is desired, a sufficient amount of the citrate solution is added to maintain this ratio of .2 per cent.

"The blood may be carried to the recipient's room or the recipient brought into the operating room. The needle is then introduced into the recipient's vein or the vein is exposed by a small incision (Figs. 210-214). The cannula is introduced and attached to a funnel or glass irrigating flask. The rubber tubing and the bottom of the flask are filled with saline solution to prevent air from getting into the circulation. The citrated blood is then transferred into the flask and permitted to flow into the vein of the recipient (Figs. 215-217). There is no occasion for hurry as the blood will not clot. On the other hand, it is advisable to have the blood run in slowly in order to guard against suddenly overloading the right heart and in order to watch for any untoward effect upon the patient. The marked slowing of the pulse, syncopal attacks, dyspnea, cyanosis, sensation of cardiac oppression or excruciating pains

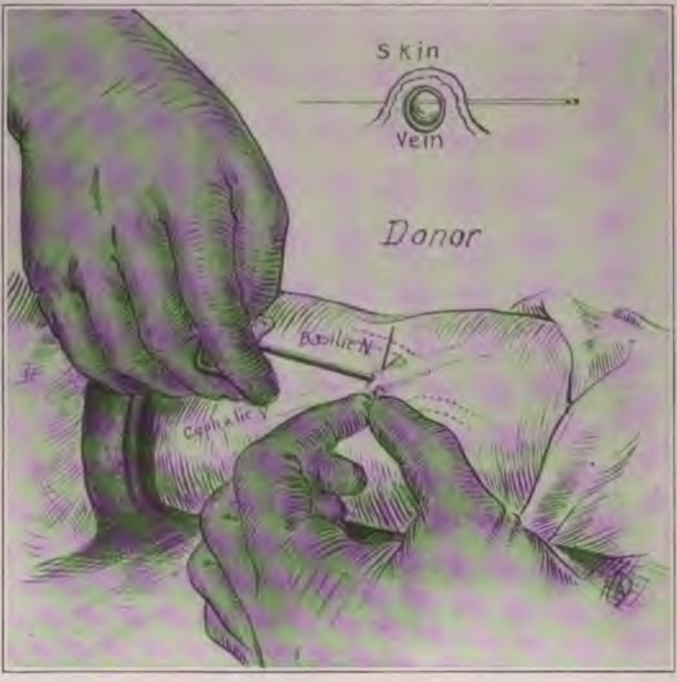


Fig. 208.—The transfusion needle introduced by the vein transfixing method. (After Pemberton.)

throughout the body, especially localized in the small of the back, should be interpreted as danger signals, and if these persist after temporary stopping of the flow, it is advisable to conclude the operation at once.''

I failed of a result in two instances because the mixture of blood and citrate solution clotted. Knowing of Dr. Pemberton's success in hundreds of instances, I wrote him for advice. The reply received is so illuminating that I give it in full.[17]

''In perhaps three or four cases I have met with the complication which you mention of having the blood show a tendency to coagulate. In two consecutive cases the blood clotted *en masse*. This was proved to be due to faulty preparation of the citrate solution in which the proper percentage of citrate was not made. The other instances have been encountered in cases in which the blood does not flow freely from the vein of the donor, in which the tourniquet has been improperly applied, when the vein is very small or in cases where the patient has become faint and blood pressure

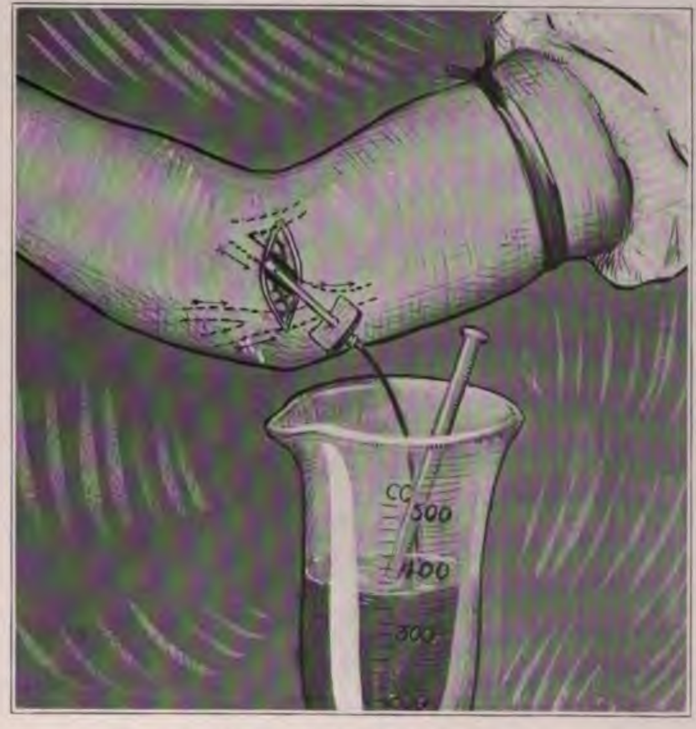


Fig. 209.—Mixing the blood with citrate solution.

has fallen. In such instances there is very likely to occur some change in the coagulability of the blood before it has reached the citrate solution, (probably prothrombin has been converted into thrombin), and when the mixture has been allowed to stand for a short time clotting takes place. Of course these complications can be easily prevented."

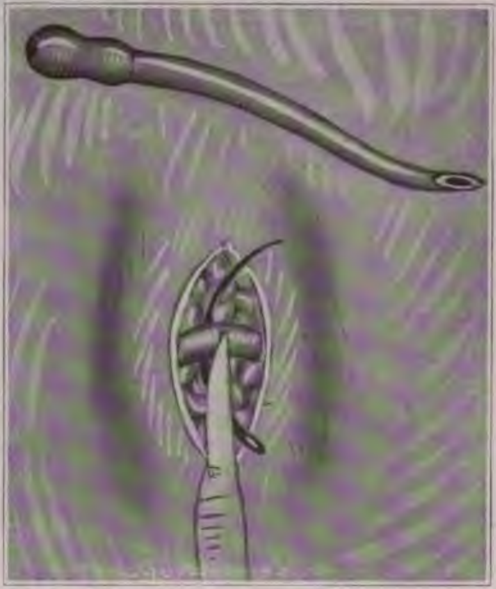


Fig. 210.—The recipient's vein held up and divided, when it can not be punctured.

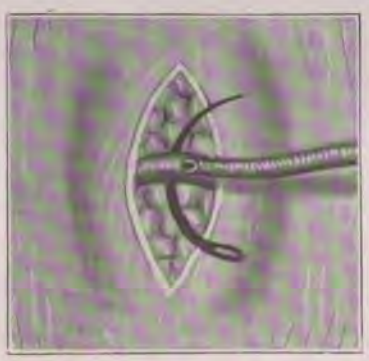


Fig. 211.—A cannula introduced into recipient's vein where skin incision is necessary.

Lewisohn[18] wrote in 1917 that "five gm. of sodium citrate can be introduced safely into an adult. Larger amounts are extremely toxic. We rarely transfuse more than 1000 c.c. of blood, which would represent 2 gm. of sodium citrate. However, even a transfusion of 1500 c.c. of blood would require only 3 gm. of sodium citrate, a perfectly safe dosage."

With this in mind, I have in my recent work ventured to modify the original procedure to the extent of using 50 c.c. of 3 per cent sodium citrate to each 500 c.c. of blood. I have been uniformly successful since doing this and feel that I can recommend the modification as tending to facilitate the procedure and to render the result certain. The citrate method is believed by us, destined to supersede all the others. The latter are not recommended as its equals, but given merely for the sake of completeness.

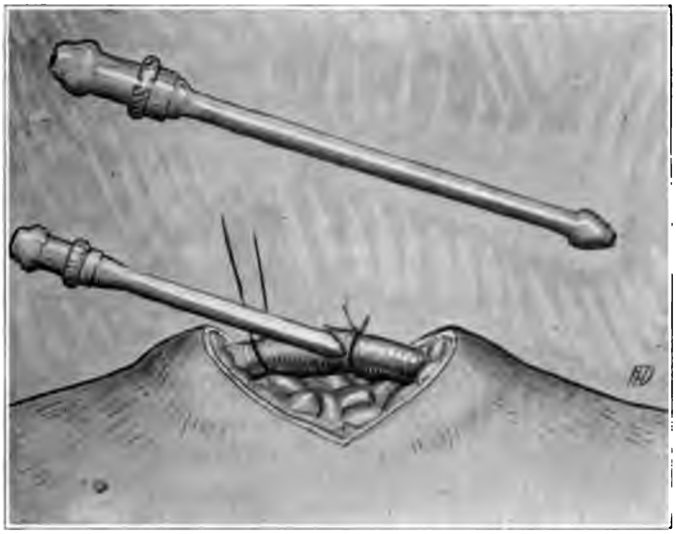


Fig. 212.—A form of cannula which may be tied in recipient's vein if not punctured.

I have no wish to confuse my readers by giving methods which I do not recommend or use, but feel that knowledge of the subject requires a perusal of the work of Satterlee and Hooker,[19] who employ pipettes which have been coated with 20 to 30 c.c. of a 10 per cent solution of sodium citrate. The fluid is poured into the pipette just previous to use and by rotating the instrument in a horizontal position, the interior is thoroughly coated. The excess is allowed to drain out through the tip, leaving about 1 c.c. of the solution which adheres as a thin film to the glass wall of the cylinder. This amount of sodium citrate (100 mg.) is sufficient to transfuse 250 c.c. of blood when used with their cannula, and the only

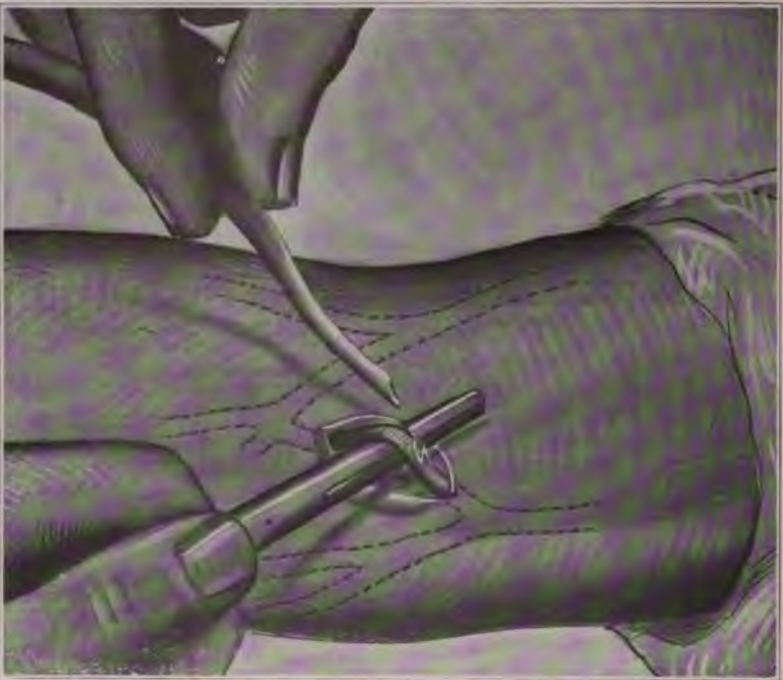


Fig. 213.—Introducing cannula into recipient's vein when puncture has not succeeded.

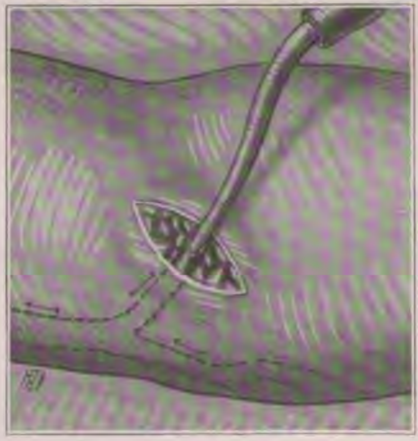


Fig. 214.—Blood entering recipient's vein.

fully citrated blood is the small (about 12 c.c.) residual portion which is retained in the pipettes. Only 38 mg. sodium citrate per 100 c.c. of blood is necessary for transfusion by this technic.

Weil[20] combines the syringe and anticoagulant methods in this way: the blood is aspirated from a vein and is at once well mixed with sodium citrate in a 10 per cent solution in water, in the proportion of 1 c.c. of solution to 10 c.c. of blood. If the mixture is made in the syringe in cases in which not more than 50 c.c. are to be transfused, the transfer can be made directly from donor to donee. If larger amounts are to be used, the blood is expelled into a flask, from which the syringe is filled. In drawing the blood it is well to use a three-way stopcock having communications with the needle, with a 10 c.c. syringe containing the citrate and with a large aspirating syringe.

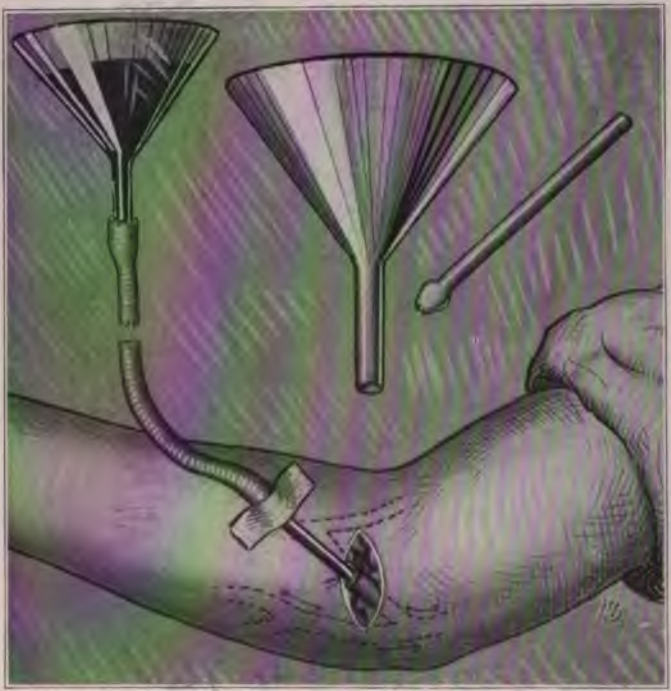


Fig. 215.—Funnel tube and a form of cannula which can be used on recipient.

Kimpton and Brown[21] have devised a method which in point of usefulness stands next to that of Lewisohn (citrate). Their apparatus consists of a glass cylinder of whatever size desired, (300 to 600 c.c.), closed at the upper end by a cork stopper, having a side tube a little below the cork, and a cannula leading from the bottom of the cylinder at such a curve that it will lead from the

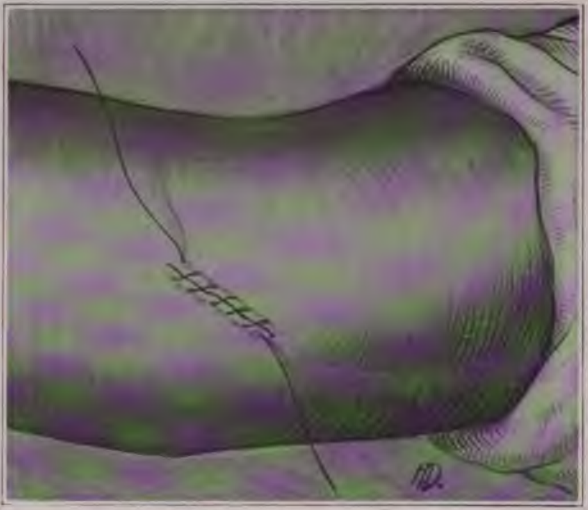


Fig. 216.—The recipient's wound sutured.

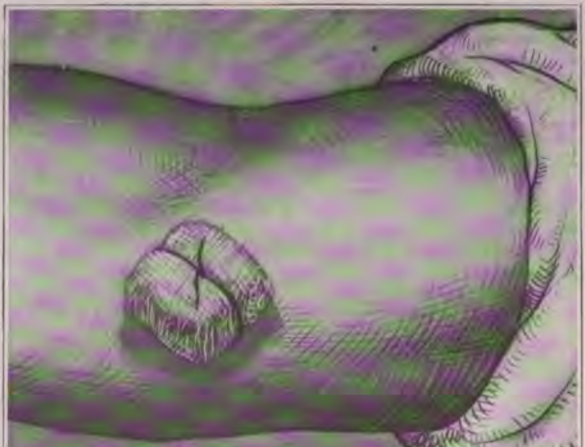


Fig. 217.—A convenient compress which is included in the ends of the suture.

upper convexity of the cylinder when the latter is placed on its side with the so-called side tube uppermost.

"The cannula bends downward just after leaving the cylinder at a right angle. From the last bend the cannula should not be more than 2 or 3 inches long, should taper gradually, and terminate in a beveled and burnished point about 2 or 3 mm. in diameter.

"A small piece of pure, clean paraffin (melting point 50° C., 122° F.) is placed in the cylinder and the cork pushed into place. The whole cylinder is then wrapped carefully in a towel, placed on its side in an autoclave and sterilized in the same manner as are dressings. At the time of the operation, the sterile tube is unwrapped by the surgeon and held above the flame of a Bunsen burner (Fig. 218), alcohol lamp, or other source of heat, and carefully revolved until the melted paraffin has covered all portions of the inner surface of the cylinder, cork, and the side tube as far as the constriction.

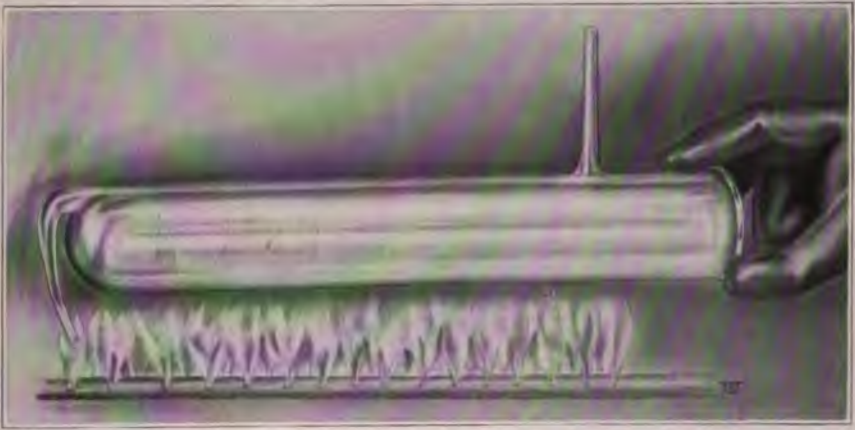


Fig. 218.—Paraffin coating in process of application.

Finally the excess is allowed to run out of the cannula, while the tip is held against a sterile gauze sponge. To avoid excessive crystallization of the paraffin, the cylinder should be cooled as quickly as possible by being brought into contact with the operator's hands. A small piece of sterile absorbent cotton is next loosely inserted into the side tube as far as the constriction, to prevent contamination from the air, and the cylinder is ready for use. Convenient veins of both donor and recipient having been bared previously, a ligature is thrown around the donor's vein proximally and around that of the recipient distally. Traction is made on the ligature around the vein of the donor, thereby elevating the vein, which is opened longitudinally with a cataract knife. The edges of the incision are held apart with mosquito forceps, small tissue forceps or fine hooks, and the tip of the tube, directed peripherally, is inserted into the lumen of the vein. The donor is directed to open and close the hand slowly, and this pumping effect causes the tube to fill very quickly (Fig. 219). A ligature around the arm above the incision will increase the rapidity of flow, but its use is not always necessary. The vein of the recipient is now opened and the tip of the tube inserted, directed centrally. The cautery bulb previously sterilized or the operator's mouth (Fig. 220) is attached to the side tube and very slight pressure is exerted. The

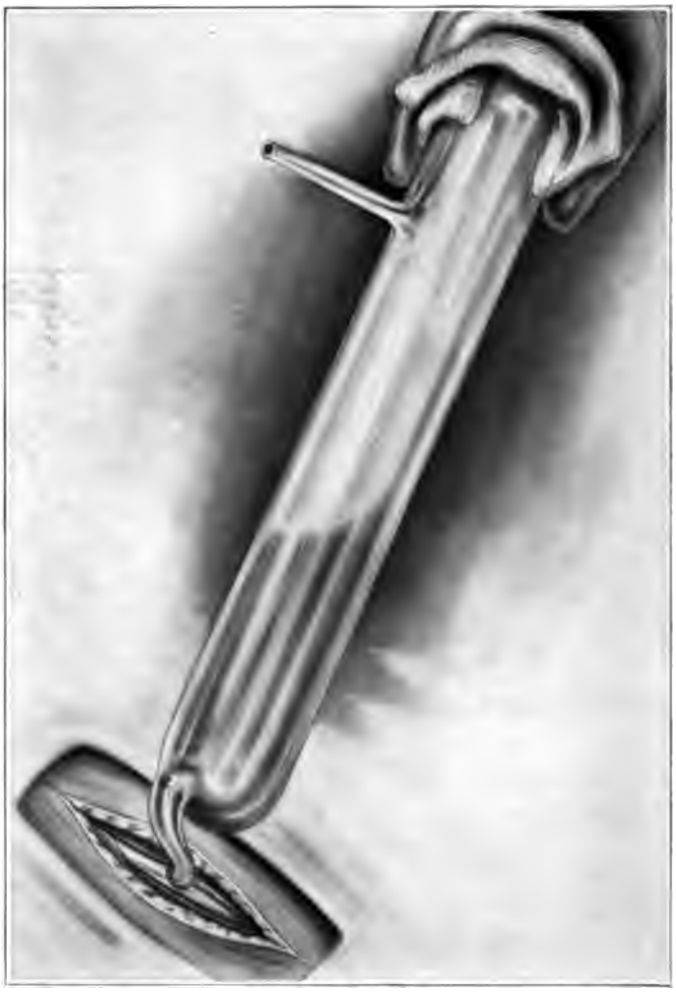


Fig. 219.—Blood running into tube from donor.

blood flows into the vein at a rate which is always under the control of the operator.''

If more blood is desired, the operation is repeated with a fresh tube, otherwise nothing remains to be done except to close the small wounds made in exposing the veins. The advantages claimed for this method are:

1. Known quantity of blood may be administered.
2. As much as 1600 c.c. can be given in 5 to 8 minutes.
3. Venous blood is utilized, so that arteries, such as the radial are not destroyed.

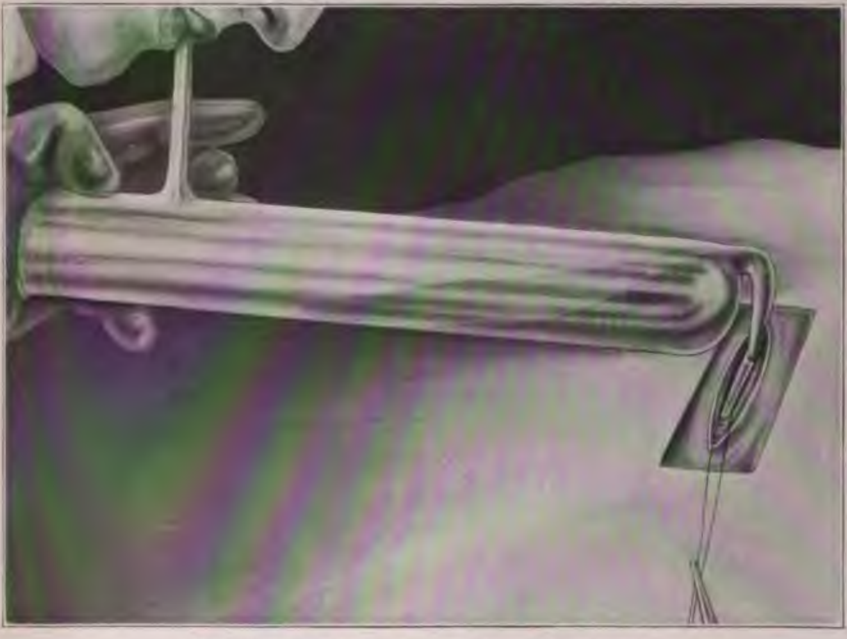


Fig. 220.—Blood being driven into recipient's vein.

4. Transfusion may be made without contaminating the donor with the blood of the recipient.
5. There is direct communication between vein and chamber by a simple paraffin lined glass tube. There are no metal, rubber or other connections, whose edges cause resistance to the flow of blood.
6. The apparatus is simple and can be made by any good glass blower.

I have never failed with this method, but must say that it is a real surgical operation. On the other hand, any physician, not an operator can do a citrate transfusion.

Percy[12] reports 54 blood transfusions effected by means of a o
piece paraffin lined, glass tube (Fig. 221), holding 650 c.c. of ven

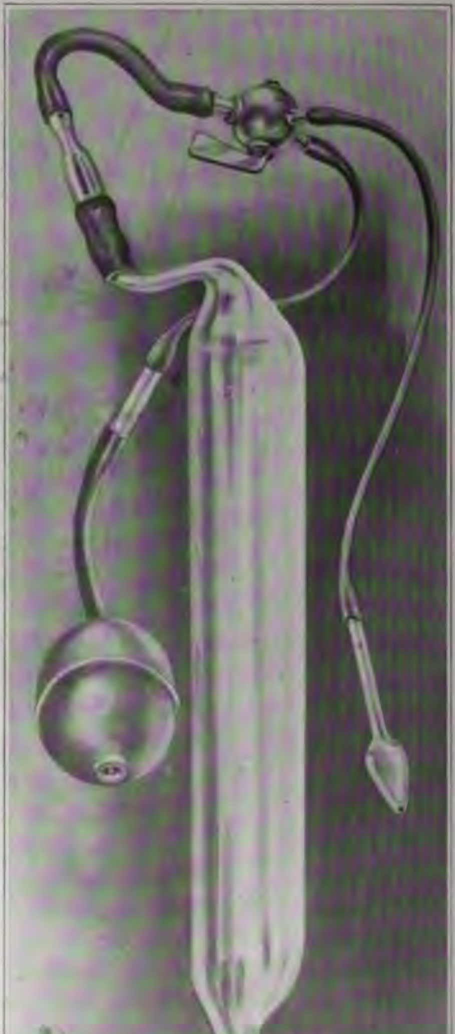


Fig. 221.—The Percy transfusion tube.

blood protected from contact with air by a floating layer of steri
liquid paraffin. His method is, in reality, an enlargement and

finement of the Kimpton-Brown idea. Percy is an expert operator and does his transfusion with a dexterity that will never be attained by most men.

Thies first suggested the *reinjection* of the blood that collected in the abdominal cavity in cases of ruptured extrauterine pregnancy. He used whole blood diluted 3 to 2, with normal salt solution in three cases and saved them all. This method is thought too dangerous on account of embolism, so Lichtenstein[22] injected 8 patients only after the blood had been mixed with a little Ringer's solution and defibrinated. During the process of defibrination and all the time the blood was out of the body, it was kept warm (body temperature) by being surrounded by warm water. After the abdominal operation the blood was injected into a vein in the arm. Lichtenstein uses a contrivance similar to a salvarsan apparatus and finds that it works well.

Henschen collects the blood in paraffined receptacles, strains it through paraffined gauge, or adds sodium citrate and then reintroduces it into a vein with the Percy transfusion instrument.

I feel compelled to *caution* the reader who intends to transfuse for the immediate treatment of profuse hemorrhage, that there is always danger of a sudden rise in blood pressure, leading to renewed bleeding from the original source, provided the hemorrhage is not known to have been accurately controlled. We question the advisability of transfusion where bleeding is in progress, when it has been controlled by packing, or when it has ceased spontaneously upon lowering of blood pressure.

A caution regarding the danger of *plethora* may not come amiss. Too voluminous or too rapid a transfusion may not only exhaust the donor but kill the recipient, hence, critical observation of both must be maintained, regardless of the method used.

When a *donor* evinces faintness or shortness of breath, he has reached the danger point. Danger signals from the *recipient's* side, will be referable to the heart: viz., precordial distress, restlessness, and shortness of breath. On examination there will be found fast pulse or later gallop rhythm, increased absolute cardiac dullness to the right, prominence of superficial veins, general cyanosis, and lastly subcrepitant rales, denoting pulmonary edema.

As Pemberton writes: "There are two other well-recognized accidents associated with and complicating blood transfusion, namely, embolism from introduction of air or clotted blood and hemolysis. The first of these is absolutely preventable by the exercise of due caution as to the technic. The third danger due to the incompatibility of the blood of the donor and the blood of the recipient, while controllable to a remarkable degree by preliminary blood tests, is *not* an absolutely preventable complication."

I can not call this chapter complete without mention of hemolysis occurring at a time when we chance it as the lesser of two evils.

Pemberton writes: "In an emergency such as that following an acute hemorrhage when the life of the patient is dependent on an immediate transfusion, we are justified in using a donor without a preliminary test. In such instances the operator should permit the first 200 c.c. of blood to run in slowly. If the patient shows symptoms of hemolysis as evidenced by suffusion of the face, dyspnea, syncopal attacks, marked slowing of the pulse rate and excruciating pains in the back, the operation should be concluded or another donor secured."

After this chapter had been sent to the publisher my coworker, Dr. George W. Ives very kindly consented to contribute an up-to-the-minute resumé of the subject, which follows:

The Selection of Donors for Transfusion

It is obvious that for donors healthy adult individuals should be selected whenever possible. Particular care should be exercised not to select as a donor an individual who is suffering from syphilis, malaria, or any other disease which may be transmitted by blood transfusion.

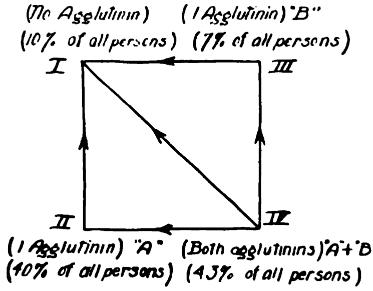
Of even greater importance, as regards the immediate interests of the patient, is the desirability that the donor's blood be compatible with that of the recipient. Serious symptoms, and even death, have occasionally so closely followed transfusions as to indicate that they are the result of the procedure. It is very probable that nearly all serious effects of transfusion can be attributed to the administration of incompatible blood.

The accompanying diagram on page 625, which was devised by Sanford,[23] I have found of extreme value in gaining a comprehension of blood grouping as regards isoagglutinins; and without this diagram, I have usually found it impossible to make the subject clear to students and clinicians. As a practical proposition isohemolysins may be neglected, since when they are present, they fall into groups which parallel the isoagglutinin groups.

Among other facts, the diagram illustrates that all individuals may be divided into four groups as regards the presence of isohemagglutinins in the blood serum. Group I includes those persons who have no agglutinin, and constitutes 10 per cent of all individuals; Group II includes those who possess agglutinin "A," and constitutes 40 per cent of all individuals. Group III includes those who possess agglutinin "B," and constitutes 7 per cent of individuals; and Group IV constitutes 43 per cent of individuals, and they possess both agglutinin "A" and agglutinin "B."

A fundamental conception in an understanding of these blood relationships is this self-evident fact: The corpuscles of a person are immune to the agglutinin or agglutinins which may be present in their blood serum. Experiment has taught that corpuscles are always susceptible of agglutination by any agglutinin which is not naturally present in their serum.

From these facts it follows that Group I serum will not agglutinate the corpuscles of any of the groups; that Group I corpuscles, since they are not protected against either agglutinin "A" or "B," will be agglutinated by the serums of the other three groups; that Group II serum, because of the presence of agglutinin "A," will agglutinate the corpuscles of both Group I and Group III, but it will have no effect on Group IV corpuscles, as they are protected against agglutinin "A;" that Group III serum will agglutinate the corpuscles of Group I and Group II, but it will have no effect on Group IV corpuscles, as they are protected against agglutinin "B;" Group IV serum will agglutinate the corpuscles of the three other groups because Group I corpuscles are susceptible to both agglutinins, Group II corpuscles are susceptible to agglutinin "B," and Group III corpuscles are susceptible to agglutinin "A."



A prospective donor's blood presents three possibilities of relationship to a prospective recipient's blood; viz., (1) The relationship is called *ideal* when donor and recipient belong to the same group; (2) The relationship is *suitable* when they belong to different groups, and when the recipient's serum will not agglutinate the corpuscles of the donor; (3) The donor is definitely ***not suitable*** when his corpuscles are agglutinated by the serum of the prospective recipient. I know of no evidence which definitely disproves my tentative belief that from a practical standpoint the relationship in the second instance is as ideal as when donor and recipient belong to the same group. If this is true, the only contraindication to blood transfusion, on the basis of blood relationships, is the third relationship.

A close analysis of the statements set forth shows that as a preliminary to transfusion, the grouping of the donor or recipient is not imperative. The only requirement is that the recipient's serum does not agglutinate the donor's corpuscles. It is highly advantageous in many instances that the grouping of the recipient and the donors be known. As it requires no more labor to determine the grouping than it does to determine the minimum information which is required, it is my practice to always determine the groups. This is easily carried out when a "standard" blood is available, and it possesses the advantage that an individual who is once grouped need not at a subsequent time be tested, whether he is a recipient or a donor.

Besides facts previously stated, Sanford's diagram illustrates the following important points: Group I individuals may receive the blood of the same group, and, as indicated by the arrows, the blood of all other groups. Any one may be a donor for 10 per cent of persons (Group I). Group II may receive the blood of both Group II and Group IV. Forty per cent of individuals may, therefore, receive the blood of 83 per cent of all persons. Group III may receive the blood from Groups III and IV, or 50 per cent of all persons may be donors to this group. Group IV may receive only Group IV blood, hence, the largest group has the smallest number of suitable donors, but the members of this group may be donors to the members of all the groups. Hence, if a Group IV donor is available, it is not imperative that the grouping of the recipient be determined, and if it is known that the recipient belongs to Group I, it is unnecessary to determine the grouping of the donor.

Several methods for group determination have been proposed. Certainly, a method which possesses simplicity, which furnishes all the information desired, which requires a minimum of time, which requires minimum amounts of blood, and which requires no special apparatus, should be selected in preference to those methods which give less certain and less rapid results, and which require more labor and considerable amounts of blood.

The writer recommends the method of Brem[24] because it possesses the following advantages: (1) It gives the complete information required. (2) The test is performed with ordinary apparatus. (3) It requires less than thirty minutes in a laboratory where these tests are commonly made. (4) It requires only a few drops of blood.

Brem's method may be used either to determine the suitability of the donor's blood without grouping, or it may be used to determine the grouping. For the purpose of the latter determination, either Group II or Group III blood must be available. This known blood, with which the unknown bloods are matched, is called the "standard." Two centrifuge tubes are required for the "standard" blood, and two for the blood of each person to be tested. The first tube of each pair should be clean and dry, and the second tube should contain about 1 c.c. of one per cent sodium citrate in 0.85 per cent sodium chloride.

The blood is obtained preferably from a finger. Into the first tube about ten drops of blood are collected. One or two drops are obtained for the second tube, and immediately it is mixed with the fluid in that tube. The corpuscles should again be well mixed, just before they are used. After the blood specimens in the first tubes of each pair have clotted, the clot is separated from the glass by means of a platinum wire, and the tubes are then centrifugalized until the serums are clear.

For a group determination, each blood requires two hanging drop preparations. The concavities of the slides should be rimmed with vaseline for the following reasons: (1) The vaseline seals the chambers and prevents the evaporation of the preparations. (2) It holds the inverted cover glasses on the slides. (3) It enlarges the chamber for the hanging drop.

The test is performed and the results interpreted as indicated by the following scheme:

	Groups			
	III	II	IV	I
2 Loops Group 2 Serum + 1 Loop (?) Serum + 1 Loop (?) Corp =	+	−	−	+
2 Loops (?) Serum + 1 Loop Group 2 Serum + 1 Loop Group 2 Corp =	+ or	− or	+ or	−

In each preparation, one loop of serum, corresponding to the corpuscles of that preparation, is used. The purpose of this serum is to protect the corpuscles against hemolysis.

In the above scheme (?) indicates "unknown," (+) indicates "agglutination," and (-) indicates "no agglutination." It will be noted that with an unknown blood four results are possible. If in both preparations there is agglutination, the tested blood belongs to Group III. This is made clear by reference to Sanford's diagram, which indicates that a blood whose serum agglutinates Group II corpuscles and whose corpuscles are agglutinated by Group II serum, belongs to Group III. If there is no agglutination in either preparation, the tested blood belongs to Group II. If the first preparation shows no agglutination, and the second does show agglutination, the unknown belongs to Group IV. If the first preparation shows agglutination and the second does not, the tested blood belongs to Group I.

To increase the rapidity and accuracy of the test, the following suggestions may be of service to the beginner. The whole blood specimens should be allowed to clot completely, otherwise plasma will be used in the test and a clot may form on the cover glasses, which will prevent agglutination. The serums should be free from corpuscles. A proper loop should be used. This is one which takes up and delivers a uniform drop. The loop should be flamed before passing it from one blood specimen to another. After the required drops are placed on a cover glass, the various drops are thoroughly mixed with the loop and then the preparation is inverted over the concavity of the slide. If the slides are gently rocked or rolled, agglutination will be greatly accelerated and the results may be known in a very few moments in nearly every instance. True agglutination is characteristic, it is rapid and should not be mistaken for rouleaux formation.

Full credit is due O. F. McKittrick for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER LVIII

THE RECONSTRUCTION OF THE PATIENT

By Robert S. Carroll, Asheville, North Carolina

The last dressing has been made, the last surgical advice has been given, and with too many operators the fact of a satisfactory surgical recovery transfers the patient into the limbo of the dismissed. Unquestionably, most traumatic cases can be discharged, not only "recovered," but well, when the surgeon or his assistant makes the last visit. Many of the acutely ill are promptly restored to satisfying health through the surgeon's interventions; ever and anon he performs miracles in rescuing chronic sufferers from beds of torture; but all too frequently the most astute surgical skill leaves the patient mechanically repaired but far from well— sadly lacking that robustness of health which should be the crowning gift of medical science. There will ever be operators, unfortunately, who can be ranked as high-grade mechanics only, operators who have never seen and never will see deeper into their patient's life-processes than can be revealed by the dissection of their scalpels. But not so with the true surgeon. He recognizes that behind many cases of appendicitis, gall bladder infections, gastric and duodenal ulcers, intractable neuralgias, bone, joint and soft tissue infections lies a depraved metabolic chemistry. He recognizes that thousands of lives of comparative inadequacy, of practical uselessness, lives of continuing years of discomfort or actual suffering persist even after the best surgical skill has been utilized in their behalf. The modern surgeon is awaking, even as the entire medical profession, to the fundamental influence of nutritional disturbances as they modify health, disease and recovery, and is recognizing that it is his or his assistant's duty to so direct the patient that recovery may mean health. The discerning surgeon also recognizes that other thousands, whom our modern intense civilization is multiplying, are ever seeking here, there and yonder, relief from symptoms which are but the expression of over-reacting mentalities—hypersensitive, suggestible neurotics. The dramatic element of surgery appeals with peculiar emphasis to the nervously inadequate, but the most astute surgical refinements leave them with their oversensitiveness untouched, with their capacity for nervous suffering unmitigated, and their deficient self-mastery unrecognized and unhelped.

Scrutiny of unsatisfactory surgical recoveries shows that the large majority of them are either nutritionally or neurotically inadequate, and should be properly grouped in one or both of these classes. The surgeon who is satisfied with only the best that science can give his patient can not be content with a surgical half-cure, but will see to it that each of his cases is given that discriminating analysis which recognizes the basic cause of the baffling and depressing residuum of postsurgical semiinvalidism.

The Nutritional Reeducation.—In our land of wealth and plenty, abundance of the good things of life has been at the command of the many for two generations. In our age of dazzling mechanical progress, the forces of Nature have become man's servitors. Abundance, even superabundance, to eat and drink is the common lot—an abundance obtained without physical effort. Meanwhile, the modern brain has become the center of human activity. Steam, electricity, and petroleum have rendered the active use of human muscle needless. Today the common nutritional defect of the successful is a broken food-oxidation balance—food oversupply, with defective muscle activity. This is evidenced especially in the persistent use of the tissue-building foods—absolutely necessary in youth and essential to the muscle-laborer—but continued into a maturity which knows only nervous activity. Such faulty dietary seldom fails by the third, usually in the second generation, to produce a disturbance in the tissue chemistry which complicates every serious operation, and frequently makes impossible an ideal recovery. And so each painstaking worker today will know the status of his patient's nitrogenous equilibrium not only by a series of accurate urea estimates, but through an equally careful tabulation of the total ammonia elimination indices. Then, as will often be the case, if the evidence of unmetabolized amino-acid excess is revealed, clear-cut, definite and far-reachingly helpful, practical advice in nutritional readjustment can be offered. Such a condition, of course, means a reduced alkaline reserve. This relative subacidosis means defective activity, not alone of kidneys and liver, but of all cell protoplasm. In such cases, appendix, gall bladder, or other surgical infection is but an incident in a generalized nutritional deficiency. The patient's true illness is a lowering of the vital activity of brain cell, muscle tissue, and secreting cells. In these patients many surgical complications occur—postoperative vomiting, unexpected infections, persistent anemias, which are unquestionably due to reduced phagocytic activity. Frequently so-called renal, hepatic, and pancreatic insufficiencies are but inadequate terms for a far more deep-seated protoplasmic insufficiency, secondary to the chronic subintoxication of protein malmetabolism. It is astonishing how many comparatively well people are today victims of the damage of protein overfeeding, and were it not that so large a percentage of them sooner or later become surgical risks, this problem would be entirely within the province of the internist.

To the muscle worker many foods are necessary fuel, which for the teacher, merchant, lawyer, and housewife can only be taken with impunity so long as liver and kidneys can stand the strain of forced elimination. In our probings into anatomic and physiologic recesses, in our theories and findings in the realm of ductless glands and the specialized activities of vicious bacterial strains, our profession has unwisely neglected the profoundly vital metabolic influence of that great bulk of our body—the voluntary muscles. Multiplied pounds of unutilized semiatrophic tissue hang flabby, a near-menace, in the sedentary individual—pounds of tissue capable of responding quickly to physiologic use, pounds of tissue capable of returning unbelievable foot-tons of energy to the man or woman who will give that care to muscles which will raise them to their possible state of efficiency. Other than fresh air and sunshine, there is probably no medicine so certain in its vitalizing effect as that which comes through a short but spirited daily use of muscles which have been normally developed and trained. For the many who have never been so developed, and who have added insult to injury, year after year, by pouring into a helpless, patient stomach the tempting, yet disorganizing viands of modern culinary skill, a nutritional reeducation will be demanded. This can not be done in a few days, but is best accomplished through six to eight weeks of properly ordered rest cure, to be followed, of course, by other weeks of the even more essentially important work therapy.

For the patient who is looking for a true reconstruction, the weeks immediately following the surgical interference are especially opportune. Little medicine is needed. One or two tablespoonfuls of coarse wheat bran, toasted brown, moistened with cream and salted to taste, taken at bedtime, and a few ounces of orange juice or equal parts of orange and grape fruit pulp taken before breakfast will usually keep the bowels in excellent condition. Four ounces of milk with one ounce of Vichy water every two hours for seven or eight feedings for three days, with milk and Vichy rapidly increased until the patient is getting ten ounces of milk, two ounces of cream, two ounces of Vichy, with one, two or even three raw eggs each feeding, will result in a few weeks in a profound nutritional reeducation. Electricity is not needed. It usually overstimulates the nervous patient and ultimately exhausts, and except as a psychic influence, is rarely beneficial. But thorough massage for half an hour morning and evening is a most excellent, practically a necessary, adjunct. Small doses of a stomachic, as tincture of calamus, or gentian compound, or better, tincture of valerian or asafetida before each feeding are helpful in modifying the normally active flatus accompanying this regime. Now and then, especially after the raw eggs are being pushed, suspension of one or two feedings and the giving of one ounce of castor oil may be necessary, if evidences of overfeeding are present. With such treatment properly carried out, the average patient will gain 20 per cent in weight in seven or eight weeks. But this comfortably fleshed, thoroughly rested patient is but partially reconstructed. She has, however, appropriated large quantities of easily digested food, and with this nutritional reserve, is in condition to receive the help which will be essentially lasting.

The transition from preparatory rest to restoring work should be started slowly. The patient may sit up ten minutes the first day, increasing ten minutes daily to one hour, and twenty minutes a day thereafter. When up an hour, ten minutes' walk may be taken, to be increased ten minutes a day to one hour. The average patient can walk three miles comfortably in this time. The next week the walking may be increased to four miles and the following week to five. Active walking should be continued daily for a number of months. Other physical exercise can helpfully be undertaken when the patient is walking three miles, any active out-of-door work, carpentering, gardening, shoveling snow in winter, medicine ball, care of the lawn—work which requires active muscular effort. At the end of the second period of eight weeks, the majority of patients should be really robust, fit to return home and stay well by devoting one or two hours a day to earnest muscular exercise. Such a program intelligently but firmly carried out would restore many who now are but half living—unworthy products of modern professional skill.

Women stand in more frequent need of the nutritional reeducation here outlined than men. For the latter, usually, a nutritional modification, only, is necessary. The limiting of tobacco, the avoidance of alcohol, an increase in oxidation through aggressive and consistent physical effort, a decided reduction in the richer protein foods—especially after thirty years of age—and a definite addition of an alkaline-producing dietary, including citrus fruits, whole wheat breads, Irish potatoes, milk and legumes, will change numbers of unsatisfactory cases into most gratifying cures. It is possible for many who are now almost hopelessly unfit, under such a regime, wisely conducted, to attain a standard of physical efficiency which makes it possible for them to remain strong, robust, and adequate, with even a daily half-hour devoted to intensive exercise. No exercise can be considered worthy of the name which does not cause forced breathing. Ordinary breathing exercises are useless, when compared with the benefits derived from the panting which accompanies active effort. The counsellor who thus advises and directs his patient, and by his personality inspires him to so alter his habits of eating and exercise that tissue metabolism may be raised to its possible high potentiality, offers him not only health, but puts into his hands that inestimable boon, super health.

The Mental Readjustment.—Unfortunately, strength of physique does not always insure peace of mind. Fears and worries and anxieties may depress and unnerve the strongest. The nervous system is constantly reacting to its surroundings. Overresponsiveness or misdirected response is the psychic defect which makes the neurotic. Lack of mental control or unwise selection of the objects of attention disturbs the nervous health and serenity of strong as well as weak. Our emotions enter into all our nervous reactions. Every act is colored or discolored by our feeling tone. A hopeful, optimistic outlook adds a potent fighting quality to every surgical case, while a doubting, fearing, complaining, pessimistic attitude not only robs the patient of a certain constructive force, but dispirits operator and nurse and adds a handicap to the entire procedure which must be reckoned with. To most of us, a surgical experience presents a strong appeal to the emotional nature. The elements of pain and danger must impress even the most phlegmatic, while in the highstrung, modern neurotic, the capacity to calmly and rationally meet the operative situation is rarely attained. The thoughtful surgeon will therefore consider carefully his every word and act realizing their lasting importance as affecting the emotional nature of his patient. Many of the nervous are highly suggestible, a weakness which, however, may be utilized by the understanding advisor to help, even as it will ever remain a definite menace in the hands of the crude or thoughtless operator. Damaging habits of feeling frequently have their birth in the experiences connected with operative or postoperative treatment. Impatience and irritability are energy leaks which should not be allowed to go on unchecked by earnest, friendly warning. Irritability is apt to beget irritability, so the surgeon who is the patient's friend will never react in kind to such an atmosphere, but with the wise word, the patient word, will show the temporary sufferer the lasting harm he is doing himself by allowing such an attitude to become habitual.

A more difficult type of patient to save from himself is the one who surrenders to a morbid sense of depression. To many natures, to surrender is much easier than to fight. To be hopeless requires less effort than to maintain faith; to be a quitter is much more comfortable than to manfully play the game. Every worker with humanity feels the dead weight of these weakling leaners, and a certain amount of each worker's strength must be given to help them drag their faltering footsteps along the path of recovery. And it is a temptation to many, otherwise strong and eager in the fulfillment of the duties involved in a noble work, to dodge these depressing natures, many of whom are pure parasites, perfectly willing to sap the vitality and energy of surgeon, nurse, and family. In helping this type of patient, a discriminating separation of classes is as essential as in the diagnosis of fractures. Many found to be sufferers from chronic autointoxication, depressed by their own poisons, can be healed through the advice given in the earlier pages of this chapter. A few will be found temperamentally inadequate—cases of mild constitutional inferiority. More are mere mendicant sympathy cravers. A jollying attitude is the simplest way of escape, but an unworthy one. The physician must be willing today to counsel, and to make clear to the depressed patient how absolutely one's attitude is of his own making; how every mortal creates his own internal weather; and how the spirit of real manhood and womanhood is capable of converting all unworthy moods into wholesome ones.

Fear is the emotion which causes the great mass of nervous harm. Fear manifests itself in numberless aspects; undue apprehension attends every step of many patients' progress through a surgical experience; and fear, as expressed through hypochondriacal ideas, lastingly discounts much perfect operative work. Many recoveries which would otherwise have been complete are alloyed by the fear element which the surgeon has carelessly allowed to persist, or recognizing, has failed to dislodge. I encounter many cases who, three, five, or even ten years after comparatively simple surgical treatment, are living the half-invalid life because they are still following the "Don'ts" of surgeon or nurse—prohibitions as to exercise and work which have grown into incapacitating phobias. Many thousands are today piteously protecting themselves from any productive effort—from even sufficient exercise to keep themselves decently comfortable—because of their ignorant fear of tearing loose some structure which was the object of the surgeon's attention months or years ago. "A" can not run the sewing machine fearing some repaired organ will be torn loose from its moorings; "B" likewise, can not sweep or stoop to dust; hundreds never play tennis or ride horseback or swim; thousands are still guarding their hypersensitive scars from even the cleansing friction of a Turkish towel. It would seem that the surgeon had impressed such patients strongly with the poor quality of his work. And too frequently it *is* the surgeon's fault; too frequently he has left the impression that he did a poor job of mending. For instead of inspiring his patients to an early strengthening of the body and toughening of the tissues through adequate use and thus developing that high grade of tissue quality which will endure and benefit by exercise and even strain, he supports and protects, and even prohibits the very use which is Nature's only method of permanent reconstruction.

Many patients are damaged through the oversolicitude of their families. In the absence of definite instruction to the contrary, they return home to be coddled and shielded and warned. Not infrequently members of the family suffer vicariously at this stage even more acutely than the patient, and would literally protect the field of operation with armor-plate, were this possible. The true surgeon strives to do his work in a way which will leave his patient fit for better living, rather than unfitted for normal life. But through overcaution many continue to live half wrecks, because they have not had specific, helpful directions for the resumption of active exercise to reestablish normal tissue tone—the quick reward of properly fed tissues naturally used. A few words of definite direction, better if written, stating clearly when exercise may be taken, what should be done, and when the handicaps attendant upon the operation may be absolutely ignored and normal living resumed, will save many a neurotic from becoming chronically and incapacitatingly hypnotized by surgery. Were proper after-treatment of surgical conditions as carefully ordered as the preparatory instructions, many half-failures would be converted into thorough successes, and operations that semiinvalidize be replaced by operations that cure.

The surgical experience presents another and a graver danger to neurotic patients who, as a class, dread pain and stand it poorly. Many of them practically refuse to endure even discomfort without artificial surcease, and the physician's temptation is a strong one to write the order which will bring the drug comfort. There are conditions, indeed, in which every dictate demands the relief of acute suffering, but the neurotic's capacity for suffering is frequently so exaggerated that he refuses to endure even minor discomforts, discomforts common to ordinary experience and entirely unrelated to surgical conditions. From these are recruited many who have become hopelessly wretched through the thoughtless or easy-going prescription of the surgeon. His influence is a potent one. If he feels it necessary for the patient to have a hypnotic every night he remains in the hospital, why not the hypnotic at home? If the hypodermic needle is the surgeon's answer to a digestive disturbance, headache, or other minor complication of convalescence, what better treatment for like conditions away from the hospital? If an hour or two of restlessness is to be placated by the harmless (?) bromide mixture while under the surgeon's care, why not bromides for restlessness growing out of home, business, or imaginary worries? And so ignorance, indifference, or selfishness on the surgeon's part has started many a poor devil toward his earthly hell. A few words of wise counsel or encouragement, a timely lavage, a dose of oil, an intelligent alteration of diet or an appeal to manhood or womanhood might have quickly met the situation, proved a lasting educative factor, and saved unmerited disaster. Through the sedative danger the surgeon may make or mar his patient's future.

The wise surgeon is primarily a wise man. The wise surgeon is a teacher, and the weeks under his care afford an opportunity for reeducation from which each normal patient will benefit. He believes and he teaches that high health can rarely be given by the knife alone, but must be earned by righteous living. He is quick to see beyond his patient's surgical needs; he is able to detect the underlying faulty habits, and through his wisdom disclose to the patient his duty to attain the health that counts and the strength that endures. And the reward which comes to such a surgeon is found in his increasing power to inspire those to whom he ministers with a determination to so attain that living becomes a joy.

Our forefathers recognized in surgery only a mutilating art. Today, more and more truly, surgery is becoming a learned, constructive, discriminating science.

CHAPTER LIX

POSTOPERATIVE TREATMENT IN CHILDREN

By Willard Bartlett and J. B. Carlisle, St. Louis, Mo.

It is the purpose of the writers of this chapter to take up the after-treatment of the most common conditions that come to the surgeon or practitioner of medicine for surgical operations or minor surgical treatment, also to consider some of the most frequent complications that follow along with such after-treatment.

After the infant has recovered from the operation, he may be placed at the breast for regular feedings. If, however, he will not nurse, he may be force-fed perferably with breast milk if it is available. Following operations for spina bifida it is important to keep the infant on his back when not nursing. This may be accomplished most effectively by pinning the night dress to the mattress or to the sheets. Elsberg[1] says that the infant may be allowed to remain on his back following the operation provided that suitable dressings have been applied to prevent the soiling of the wound by urine or fecal material. For this he uses a collodion dressing.

Following operations on harelip as a rule no treatment is necessary unless the sutures have been placed in too tightly. If such is the case a strip of adhesive from cheek to cheek will probably lessen the tension sufficiently. Here again when this operation is on a young infant the feeding may be started as soon as possible, either by having the infant nurse or by force feeding. V. P. Blair[2] in writing of the Lane and the Brophy operations for congenital palates or lip clefts says that these operations should be done on infants as soon after birth as possible. He further states that the depressions due to the loss of blood can be met by saline by rectum. He gives these infants four cubic centimeters of castor oil and six hundredths of paregoric by mouth a few hours after the operation to remove the blood swallowed during the procedure. The infant is given water by mouth as soon as it cries, and then is fed when this will no longer satisfy. Usually these infants are fed four to six hours after the operation. If human milk is available, it should, of course, be given, but if not the feeding of modified milk should be started as soon as possible. Blair further states that in older infants sometimes an anodyne is necessary during the first forty-eight hours after the operation. He uses morphine or paregoric in very small doses when the infant can not be quieted by the nurse. It is often well to spray the throat of the infant with some antiseptic following the operation. He uses saline for this, gently spraying with it every two hours during the day and at the feeding times at night. He states also that the site of the operation should be carefully watched, and should signs of infection appear, the part should be painted with a 10 per cent colloidal silver solution after each irrigation with the saline. To children with congenital palates requiring plastic operations Blair gives liquids and solids for the first ten days and all food and water given for the first few days is sterile. He does not allow these patients to talk for ten days, but they are allowed to get up on the second or third day after the operation if they have no increased temperature. Various antiseptic solutions may be used in these cases as irrigations. Hemorrhage sometimes occurs following these operations. This may be controlled by the use of astringents or by packing with gauze. In case that these measures are not effective, then the patient may be anesthetized and the bleeder sought and ligated. Sutures as a rule may be removed at the end of a week.

Intubation when done entails as a rule but little after-treatment. Following the operation the infant may be allowed to nurse, but if he refuses, force feeding may be used. In the case of a child liquids and semisolids may be given. Holt and Howland[3] say that older children often experience some difficulty in taking food, and for these they recommend the device of Casselberry; namely, that of having the patient's head lower than his body while he drinks. Often in these patients the taking of food and water may cause excessive coughing. In these cases food and water may be given by a nasal tube or the stomach tube. Dyspnea may be caused by the child swallowing the tube or the tube becoming filled with mucus. The examination of such a patient should first be to see whether the tube is in place. An intubation tube should be cleansed once a day or more if the case demands. Holt further suggests that should the tube at any time be coughed up, it should not be replaced until dyspnea appears again. The length of time that the child should wear this tube is, of course, variable in different cases. Usually extubation is done when the child's temperature reaches normal.

The removal of tuberculous glands in children requires little local after-treatment except in keeping the wound free from secondary infection. The general treatment is usually of much more value.

tending to build the child's condition up with tonics, fresh air, good food, and good hygiene in general.

Furunculosis which so frequently occurs in children can best be treated by stock vaccines of the staphylococcus or by an autogenous vaccine if such are available. General tonics are sometimes of value for the accompanying digestive disorders. Yeast may be used in some cases as reported by Hawk with benefit. As a rule, however, autogenous vaccines are of more value. Distant reinfections are best prevented by frequent cleansing of the patient's fingers with alcohol.

Following the removal of tonsils and adenoids primary or secondary hemorrhage may occur. Primary hemorrhage is usually very slight and can be controlled with certain astringents such as adrenalin or hydrogen peroxide or by the use of pressure or packs. Secondary hemorrhage is usually more severe, sometimes becoming so severe as to require suturing as described by Coolidge.[4] This method consists, after the patient is etherized, in passing a curved needle from behind forward through the posterior pillar, the constrictor muscle, and the anterior pillar. These three sutures thus placed will obliterate the space of the removed tonsil and are effective in stopping the bleeding. The sutures may then be removed in three or four days unless catgut has been used. Some cases of secondary hemorrhage developing three or four hours after the operation or the next day may be stopped by simple packing and by ligation of the vessel when it can be seen. Hemorrhage following removal of adenoids may usually be controlled by packing.

In children who have long been accustomed to breathing through their mouths it may be necessary to apply a bandage to force them to breathe through the nose until they have become accustomed to it. As a rule, following removal of tonsils and adenoids it is well to have the patients, especially young children, stay in bed a day or two during which time they should be carefully watched for the development of secondary hemorrhage. The diet during this time should be a light one. It is also well to spray the throat with some mild antiseptic solution for several days after the operation. If they have no increased temperature at the end of the second day, they may be allowed to get up.

The postoperative treatment in empyema is a very important one because empyema itself may complicate any of the infectious diseases that are so common in children. It may also come as the result of trauma. The opening of the thorax may be followed by drainage in a number of ways. Perhaps the method of Kinyon spoken of by

Holt[3] is as good a one as any. This method consists of a siphon drainage into a bottle containing saline. In those cases that he terms "desperately sick" Wyman Whittemore[5] advised a somewhat different treatment: "Under local anesthesia the chest is aspirated between the ribs with a large trocar; a tight-fitting catheter slipped through this and the trocar removed. The catheter is attached to a long rubber tube that goes to a bottle half filled with water. The end of the tube is under the surface of the water. The catheter is screwed tightly into place. In this way the negative pressure of the pleural cavity is not changed and with each expansion of the lung the pus is forced into the bottle. The catheter will stay tight within the chest wall for about a week. The amount of drainage for each twenty-four hours is measured. At the end of five or six days an electric suction is attached to the tube. This works constantly, and when the twenty-four hour amount of pus is down to two ounces, I remove all drainage apparatus. In those cases not quite so severe the Lilienthal operation is used." The postoperative treatment in both of these cases is practically the same. Good food, fresh air, regular breathing exercises are to be insisted upon and also the "blow bottles" in some cases. Whittemore does not think that bottles are of much value.

In some cases in which the drainage of the cavity is insufficient it is sometimes necessary to irrigate. These irrigations may be done with saline, but more recently many are doing them by using the Carrel-Dakin solution. It is the practice at the St. Louis Children's Hospital to use the Wilson tube in drainage and in those cases which require irrigation Carrel-Dakin solution is used in small amounts at frequent intervals. The general after-treatment in all cases is essentially the giving of good food, plenty of time out of doors in suitable weather, and the forced expansion of the lung. James' apparatus which is a blowing device of two bottles is sometimes very effective in expanding them.

Frequently the temperature will again rise following insufficient drainage of the cavity, due to a developing pneumonia, to empyema of the opposite side, to pericarditis, or to otitis. All of these conditions must be carefully watched for and treated early if they appear. In the chronic cases of empyema practically all the treatment that is necessary is to keep the wound as clean as possible, promote adequate drainage, and in general attempt to increase the resistance of the patient. Beck's paste may be used in these cases. It is well to remember that in the acute cases a drainage tube left in too long will often lead to a fistula.

Stricture of the esophagus in children is not uncommonly seen due to lye or other powerful caustics. Such cases as these are often not seen by the surgeon until late after the swallowing of such materials. The starvation and the extreme water hunger in these cases when seen often demand an immediate gastrostomy as pointed out by Hubbard.[6] Following such a treatment the surgeon should attempt to pass (possibly retrograde) whalebone filiforms or the smallest bougies as soon as possible. Certain of these cases can have the esophagus after a long and tedious process, dilated to a point where after several days the gastrostomy wound may be closed and the feeding by mouth resumed. These patients should return to the surgeon for regular dilatations of the esophagus. In the case of the child, this point must be thoroughly impressed upon the parents so that not one of these dilatations shall be missed. Another point which is of equal importance and was brought out in the article referred to above is that these patients are often for a long time fed upon liquids and semisolids which do not furnish sufficient nourishment and lead to malnutrition and lack of proper development. They, he says, may be allowed to eat all kinds of foods if they are taught to masticate well what they do eat. In certain cases where the stricture of the esophagus is of such a nature that the bougie or the small whalebone filiforms can not be passed from above an attempt may be made to have the child swallow a string and if successful then the dilatation can be attempted from below through the gastrostomy wound.

The postoperative treatment of pyloric stenosis in children is a very important one, and one about which a great deal has been written. Most writers, however, are agreed upon one point, and that is that the postoperative treatment is usually of as much importance as the operative treatment itself. For this condition in infants there are two methods of after-treatment which are very different. Green and Silbury[7] write of the after-treatment following the Rammstedt operation as follows: "The infant must have breast milk in small quantities, gradually increased. The method of the Babies' Hospital in New York is followed. The feeding is started two hours after the operation, or when the baby is awake from the anesthetic, with four cubic centimeters of breast milk and the same amount of barley water every three hours, increasing by four cubic centimeters of breast milk every other feeding until we get the breast milk up to thirty cubic centimeters and then we give thirty cubic centimeters of breast milk every four hours during the day and at night. The baby is not allowed to nurse the mother for from five to seven days after the operation, and when it does, is weighed before and after each feeding to determine the amount obtained. Castor oil is given twenty-four hours after the operation. Practically every case that we have treated has received an anteoperative hypodermoclysis and some few have received it after the operation. The greatest care must be taken not to chill the infant during the operation, and after it external heat should be applied." In general the cooperation of the surgeon and the pediatrist is required in these cases to insure success. Thompson[8] says "that shock and hemorrhage must be avoided after the operation and that shock may be combated with warm saline infusions or transfusions and by mild stimulations if necessary. Rectal feeding or saline enemata may be employed for a few hours or longer. Food per orem can be administered in a few hours or the next day and this is often necessary on account of the precarious condition of the child and its imperative need for nourishment." Morse and Cabot[9] also recommend postoperative salt enemata. They say that feeding may be begun in the child as soon as the effects of the anesthetic are passed. They recommend human milk diluted with three parts of water, the strength being gradually increased, but if breast milk can not be obtained, then whey is the next best gradually to be strengthened by gravity cream to 1 per cent of fat. They consider it best to feed one dram every hour, increasing the amount and lengthening the interval between the feeding.

Most surgeons now have adopted the Rammstedt operation in preference to the older gastroenterostomy which is attended by a higher mortality, more shock, and a slower convalescence. In a case where a gastroenterostomy is done the infant can not be fed as soon after the operation and the feeding in general must be more cautiously carried out than in the case of the infant upon whom the Rammstedt operation has been done. Holt and Howland[10] recommend another treatment. The infant is given one or two teaspoonsful of breast milk every two hours alternating with the same amount of water. The amount is gradually increased and the interval is lengthened until at the end of forty-eight hours the infant is getting an ounce of milk every three hours and the same amount of water between the feedings. At the end of a week or ten days the infant may be put back to the breast and allowed to nurse, but care should be taken that it does not nurse too long or does not get too much at any one feeding. Holt further states that hypodermoclysis is of value at the beginning of the operation and after it. In these cases 100 to 240 c.c. of saline, to which 3 per cent of glucose has been added may be given to relieve the lack of water. The importance of the after-treatment in these cases can not be overestimated. With an early recognition of the condition, a Rammstedt operation in the hands of a good surgeon, and then careful treatment afterwards by an experienced pediatrist the chances for the infant's recovery ought to be very good.

Umbilical hernia rarely occurs in children under four that is not amenable to mechanical rather than surgical treatment. If, however, this treatment will not suffice, and the child has to undergo an operation, then the after-treatment consists in meeting hemorrhage, should it occur, or shock, and the feeding of the infant. Shock may be treated with saline and glucose solutions. The treatment of hemorrhage is the same as that for hemorrhage in other abdominal conditions. The feeding may be begun as soon as the child is over the operation, the nature of the feeding and the times for it depending on the age of the patient. Very strenuous efforts at play must be avoided for a few weeks after he is up at the end of ten days. The prognosis is one hundred per cent good.

Intestinal obstructions due to malformations of the intestines are sometimes seen in the newborn due to atresia or absence of the rectum, colon, or anus. The mortality in these cases is usually very high due to the late period at which they are recognized or to the marasmus existing at that time. Should an operation be done on these infants, the after-treatment will depend a great deal on the nature and the extent of it, but in general it will be the same as that following an operation for an umbilical hernia. The after-treatment in cases of obstruction following intussusception is very important, but as a rule presents nothing different from that accorded obstruction due to malformation. Lack of water is often of very grave importance in these conditions. This can be combated by giving water, saline or saline and glucose if preferred, subcutaneously, intravenously or into the peritoneal cavity. This last method is the one employed at the St. Louis Children's Hospital in cases of anhydremia with good results.

Although appendicitis is a disease usually seen in adults, it may be seen in infancy and is frequently seen in children. The after-treatment in such cases occurring in children is much the same as that in adults. Those general principles outlined by Ochsner,[11] may be followed. In his uncomplicated cases in which drainage has not been used the patients are given no food by mouth for three to seven days according to the conditions. Gastric lavage is employed in patients who are nauseated, nutrition being supplied to these patients by rectum. Solid foods are not usually given until two weeks after the operation. The stitches are removed on the tenth to the fifteenth day and then adhesive is placed over the wound for support. In those cases demanding drainage boric acid dressings are used. As a rule in the uncomplicated cases patients are kept in bed two weeks. A resulting ventral hernia in children is so rare that it hardly deserves mention in this treatise.

In general the temperature in these cases of appendicitis in children should be carefully watched, and should any sign of peritonitis develop, all feeding by mouth should be stopped if it has been started. The lesion may then be treated as is done in adults with hypodermoclysis, morphine, etc.

Renal calculi are very common in infancy according to Holt and Howland.[12] The postoperative treatment in these cases depends on the type of operation that is done. If the pelvis is opened and the calculi removed, the after-treatment will be simple unless hemorrhage or a urinary fistula develops. A urinary fistula would demand a second operation if possible. The feeding of these infants, like the feeding of infants following the Rammstedt operation, is sometimes very important. The general measures to be followed in such a feeding are to give breast milk if possible in small doses, increasing the amounts and finally when possible the return of the child to the breast. Water hunger if it occurs following the operation can be relieved by saline infusions. Osteomyelitis is so fully considered in the chapter "Surgery of the Extremities" that it will be omitted here. It can occur in infants, but more frequently is seen in children.

Scudder[13] says that fully one-third of the fractures of the clavicle occur in children under five years of age. The treatment in these cases after the deformity is corrected lies in the immobilization of the part for two weeks or more. The arm should be inspected especially in warm weather to see that no chafing of the part occurs. All the dressings should be daily removed, the parts bathed with soap and water, powdered and the dressings replaced. If the union is firm after two weeks or two weeks and a half, the cast may be removed and the shoulder can then be put up in a simple retentive swathe and sling, at first inside the clothes and later outside them. Massage may be given to the forearm, elbow, and shoulder after the first week together with passive motion of the elbow. If the dressing chafes or slips, it may need frequent renewal.

Fracture of the shaft of the humerus sometimes occurs in the newborn and has for its after-treatment the same principles as outlined above for fractures of the clavicle. Scudder treats the fractures of the femur in the newborn by flexing the leg upon the body. The after-treatment in these cases consists in the daily massage of the leg and the preventing of the parts from chafing.

In general, fractures in infancy are uncommon but they are rather common in children. The general treatment in all cases is the protection of the skin and the proper immobilization of the part to insure correct healing of the fracture. As a routine it is well to take a second x-ray picture of the fracture after ten days or two weeks to see whether or not the bones are properly approximated.

Burns, when seen in children, are most commonly those of the extremities. The use of paraffin dressings or the dry heat treatment is used in most hospitals now. This heat may be applied by means of a tent over the extremity which has an electric light bulb on the inside. When crusts form on these burns they should be removed and a dressing of scarlet red applied. In the case of the more serious lesions a Thiersch graft may be applied. As in the case of adults it is also necessary to produce proper elimination of the toxins of a severe burn through the kidneys, skin, and the bowels.

Full credit is due J. B. Carlisle for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER LX

POSTOPERATIVE TREATMENT IN OLD AGE

By Willard Bartlett and C. R. Fancher, St. Louis, Mo.

Before considering postoperative treatment in old age, it would be well to consider that every old person has a definite and more or less constant pathology. Certain modifications at once arrest your attention. Every one is familiar with the appearance of an old man or woman. We find as we look at an elderly individual, a great change has come over the face. The roundness of youth has departed; the cheeks are shrunk; the eyes have receded; the lips are drawn in. The gait becomes shuffling; the foot is no longer lifted free from the ground as the aged individual walks along.

The skin becomes thin and satiny, while disappearance of fat and muscle tissue beneath it throws it into wrinkles, the hair after becoming white falls out, the muscles waste away and grow weak; and the ligaments which bind together the bones stretch and weaken. Deprived of its strong muscular and ligamentous support, the back bends forward, the bones become rarefied and the cartilaginous structures become ossified. The bones break more easily and heal with greater difficulty than in a young person, all of which correspond to a general atrophy of the individual, for, at the same time stature diminishes and the weight of the body generally decreases. This emaciation is the consequence of a morbid process which exerts its action upon the muscles of organic life and upon the greater number of the organs, e. g., the brain, spinal cord, nerve trunks, lungs, cardiovascular system, kidneys, and blood-forming organs all participate in this retrograde process.

Of what does this change in the collective organs and tissues consist?

First: In the slightest degree, it is a simple process of atrophy, the cellular elements of the parenchyma, the muscular, and perhaps also the nervous tissues, progressively diminish in volume, but without any demonstrable change in structure. But in a more advanced stage atrophy is accompanied by degenerative action; i. e., the tissues undergo a modification in their anatomic and physiologic activities, and we find that they are the seat of pigmentary, also fatty degenerations, and calcareous incrustations.

No one will fail to observe that if these changes have attained a pronounced degree, they will go beyond the limit of the physiologic state, since they have the power to produce of themselves, functional derangements which at times are extremely grave. The generative and muscular systems undergo so evident an enfeeblement that it is not necessary to dwell upon this point, and with regard to the nervous system of organic life it is well to recall the well-known lines of Lucretius, "Praeterera gigni pariter cum corpore, et una crescere sentimus, pariterque senescere mentem"—De Nat. Rerum, ii, 446.

Mental changes may manifest themselves as a senile dementia, confusion, mania, melancholia, or as a senile "paranoia." This is of considerable importance in considering the various mental conditions, the whims and fancies which sick old people are liable to have.

The functions of the respiratory apparatus are as a whole generally decreased. This will be evident when we consider for a moment the pathology of the senile lung and thoracic cavity. The senile lung is emphysematous. The walls of the arteries are inelastic, large numbers of capillary vessels have been obliterated and intermixed throughout the entire structure there is always found a diffusion of carbonaceous material. The senile lungs can not be perfectly inflated, and present a livid appearance. Thin surfaces are uneven and look as though they were crumpled. Not only do the previously mentioned factors decrease the respiratory functions, but also the musculature of the chest becomes atrophic; the costal cartilages become ossified, all of which prevent or hinder the complete filling of the lungs. Many investigators think that these changes begin as early as the thirty-fifth year and reach a maximum about the seventy-fifth year.

The cardiovascular system is profoundly involved in senility. The heart, like every other organ in the body, undergoes atrophy and shows various degenerative changes which directly lead to an inefficient organ. The heart usually becomes small and brown with tortuous coronary arteries, which are visible through the watery, brownish fat. The fat of the epicardium usually disappears and its cells become separated by a fluid which gives a gelatinous appearance to the tissue. The decrease in the size of the heart makes it too small for the coronary vessels, which, therefore, take the tortuous course above mentioned. Each heart muscle cell is greatly reduced in size, and there show at the poles of the nuclei certain brown pigmentations which constitute the so-called "brown atrophy" of the myocardium.

Besides the senile changes that take place in the heart, the very important sclerotic changes that take place in the vessels are of next importance; the effects of this sclerotic change causing, of course, an abnormal vascular wall, which is inelastic and gradually encroaches on the vascular lumen. This decrease in cross section of the vessels causes a decrease in the quantity of blood brought to any given organ; also causes an increase in the amount of cardiac work due to the increased peripheral resistance.

The kidneys are affected in senility, the change usually found being the so-called "arteriosclerotic kidney," in which the organ is contracted, and the thickened capsule generally adherent. On section the kidney shows macroscopically certain localized areas of atrophy. There is a disappearance of the pelvic fat, and a marked decrease in the cortical and pyramidal portions.[1] In the senile kidney the urine is generally decreased. The urine analysis shows hyaline and granular casts and usually a trace of albumin. The amount of albumin varies greatly with the food and the amount of exercise taken. Casts may occur without the albumin. It is not to be regarded as a grave sign to find any of the above in a senile individual.

The liver in senility shows a flabby, shrunken organ usually of a dark color made up of lobules far smaller than normal; often whole layers of liver tissue disappear; so that on the surface of the organ, blood vessels, bile ducts, and the fibrous skeleton of the liver lie exposed. All of these senile changes must play a very important, yet comparatively unknown, part in the metabolism of the individual, also on the metabolic changes going on in the liver itself. The liver is known to have something to do with the metabolism of the more complex amino acids, and it is conceivable that a perverted liver metabolism might have something to do with the pigmentations which are so common in aged individuals, due of course, to the incompletely broken-up amino acids which contain color groups. The skin is affected more than any other single organ in senility. It, like any other organ, undergoes definite changes; since it is dependent on other systems of the body for its well being, and in order to maintain its equilibrium, i. e., chemical and physical, must have the proper food and environment. The senile skin shows very important changes which really mark the beginning of the end. The causes are not known, but they usually start in the vessels of the true skin. This decreased nutrition allows infection, causes itching and gangrene. There are also changes in the connective tissues; there is an atrophy without adequate repair, instability and irritability of the epidermal cells, which have a tendency to a typical and rapid transformation. Therefore, we find pigmented plaques and warts which, along with the previously mentioned factors, predispose to carcinomata, hence they are potentially cancers. Sir James Paget once said, "If we live long enough, we will all die of cancer," and from senile skin findings this is quite true. Most dermatologists are agreed that senility of the skin does not mean in all cases age in years, but skin changes are sometimes due to processes not well understood. Senile skin changes are usually first noticed on the dorsum of the hands and the sides of the neck. One of the most striking alterations in the skin of an old individual is the lack of repair. The slightest amount of trauma very frequently will cause a very severe dermatitis or an ulcer.

From what has been said it is quite evident that old age is essentially a period of involution, of diminished power for sustained expenditure of energy, and, commonly, of a lessening in the general range of activities. The organism begins to reveal gradual and increasing changes in its structure, all of which are expressive of senescence.[2] Noticeably is this the case of the cardiovascular system. The heart no longer has the power to drive the blood with its former energy, while the vessels present walls no longer soft and yielding, but now rigid and with a narrowed lumen. The changes of function that ensue, are, however, in a vast majority of mankind, entirely normal and in no sense pathologic. There is a quantitative reduction, but this is usually limited in degree so that the individual may continue to discharge his functions normally to the end of life. It is only when this reduction is excessive, and especially when it is associated with qualitative changes, that it becomes pathologic.

The surgical after-treatment in the aged does not differ in the main from the postoperative treatment of adults. In the first place, age is a contraindication to operations of the more serious nature.

Old individuals can not stand shock; their fighting powers, one might say, are far from what you would expect in an adult. Some of the more salient points to be considered in the after-treatment are as follows:

1. During the operation and after the operation the patient should be kept warm. This may be accomplished by having a warm operat-

ing room, covering the patient with previously warmed blankets, or surrounding him with hot-water bags.

2. The preparation of the bed is quite essential. It should be prepared before the patient comes from the operating room, i. e., previously warmed by the use of warmed blankets, hot-water bags, electric bakes, etc.

3. When the patient arrives from the operating room, he should be carried by at least four people, and should be gently placed in bed, and snugly covered. Hot-water bags or an electric bake may be used to maintain the desired warmth of the bed. It is very essential that aged individuals receive all of the heat possible. They are in a way analogous to an infant that has to be kept in an incubator. The factors involved in the two cases are quite similar.

4. The patient's room should be well ventilated, quiet, and properly heated. It is a good idea to get aged patients out into the fresh air and sunshine as soon as possible; and if climatic conditions are favorable, this point should never be overlooked.

5. The processes of elimination are very frequently embarrassed in the aged by reason of senile changes previously considered. Fluids should be forced unless some contraindication is present. They may be administered by rectum, mouth, subcutaneously, or into a vein. Patients should have a daily bath and all of the avenues of excretion freely opened.

6. Among all the complications found in senility the most feared are perhaps the various forms of pneumonia. For the consideration of bronchopneumonia and lobar pneumonia the reader is referred to any standard textbooks of medicine. Ether pneumonia and hypostatic pneumonia are the two forms with which we are directly concerned. The ether pneumonia is not so frequent in the aged as it was at one time. It might be disposed of by stating that it is always much safer to give the ether by the open method.

7. Hypostatic pneumonia is primarily limited to aged individuals and those who have an enfeebled cardiovascular system, or to individuals who lie in the recumbent position, or any position at all for a long period of time; the treatment is obvious.

a. Patient must be examined regularly (always look for physical signs around the bases of the lungs).

b. Patient should be turned frequently and not be allowed to occupy the same position for any great length of time.

c. Cardiovascular and excretory systems should be stimulated.

d. Free bleeding may be resorted to and as much as 10-20 oz. of blood may be removed. Some advocate aspirating the right auricle, but this seems to be a very heroic measure and should only be used as a last resort.[3]

Hypostatic pneumonia is always to be feared in fracture cases, especially in fractures involving the hip or spine.

8. Bedsores, or decubital ulcers, are very likely to occur in bedridden patients. The parts most exposed to pressure become red and congested, and finally ulcerate, or gangrene supervenes. Bed sores are not usually extensive or deep, but if the patient is debilitated or paralyzed, the process may extend rapidly and involve deeper structures. Bed sores may be so extensive as to involve bone, causing necrosis and caries (the so-called acute bed sore).[4] Cases have been known in which the spinal canal was opened up, and in this way, death may ensue from a meningitis. To prevent the occurrence of bed sores the nurse or attendant should see that the draw sheet and bed linen are placed smoothly, and without creases, also that there is no contamination by urine or feces. "The skin of the back should be daily washed with some nonirritating soap; rubbed with a soothing, strengthening, and hardening application, such as a mixture of brandy and white of egg, then dusted over with a powder consisting of equal parts of zinc oxide, starch, and boric acid. If the skin becomes red, it should be painted with a mixture of tincture of catechu and liquor plumbi subacetatis, which, when dry, leaves a powdery film on the surface. It must be protected from pressure by a circular water bag or an air pillow."[1] Paralytic or very debilitated patients should be placed on an air mattress. When an open sore forms, fomentations are required during the more acute stages, also irrigations with saline are very beneficial; later the open sore may be dressed with a boric acid ointment;[4] occasionally touching up the ulcer with $AgNO_3$ stimulates granulation, the primary procedure, of course, being to keep the open sores clean.

9. The elimination via the gastrointestinal tract must be assisted in all cases of constipation. The condition or kind of operation done, will, of course, influence the administration of a cathartic. Ordinarily, patients not having abdominal or rectal operations should have a bowel movement at least once a day. If this is not possible, any of the following measures may be resorted to:

1. Saline, soap suds, or oil enemata.
2. Castor oil or any of the less drastic cathartics.
3. In case a fecal mass becomes impacted in the lower sigmoid or rectum, this should be removed by means of a spatula or by the fingers.

Constipation and gastrointestinal upsets are very frequent in the aged, due to the fact that the musculature of the intestine becomes more or less atonic and the secretions are greatly decreased.

10. The diet is one of the most important parts of the postoperative treatment. As was previously stated, aged individuals are like infants in many respects.[5] Their metabolism due to senile changes is going the wrong way. As was previously stated, the senile changes of every cell and gastrointestinal secretion have taken place. So it is evident that an aged individual is not able to metabolize as a younger person. It has been estimated that an individual at rest or doing light work requires about 2500 calories. This should be composed of very easily digested and tasty foods. Aged individuals handle bland and liquid diets very well. These, of course, should be well balanced, they can not take care of the heavier foods. This is partly due to the fact that their secretory functions are somewhat inhibited; also their mastication is deficient.

Senile individuals may be nourished frequently by the administration of eggnogs and malted milk, which are very nourishing and thankfully received by the patient. Here, again, the kind of operation will greatly determine the diet, especially the method of administration; also if the patient is a diabetic or a gouty individual, it is the duty of the dietitian to provide a diet which is free from, or very low in, carbohydrates in the former, and a very low protein, or protein-free, diet in the latter.

11. Urinary retention is very common in elderly individuals. This may be due to abnormal conditions in the kidney, bladder, cord lesion, prostatic hypertrophy or to a urethral stricture. As previously stated, the sclerotic kidney may be a factor in diminished urinary output. The only treatment is to force fluids and administer diuretics. The arterial condition is sometimes helped by giving potassium iodide, sat. sol. gtt. x t.i.d. If a calculus is the cause, the only treatment outside of surgery is to keep the patient free of pain while the stone is being passed. Patients very frequently pass stones spontaneously, or they may be removed by mechanical means. Papaverine, one of the alkaloids of opium, is supposed to affect the musculature of the ureter in a specific manner, causing a series of relaxations and contractions. This, however, is only experimental, but may be tried. The papaverine should be given in ¼ gr. doses, and not repeated oftener than every six hours.

The bladder may be the etiologic factor, the retention being due to an atonic musculature or to a lesion of the central nervous system. The senile bladder is very easily infected and if one is

In the previously mentioned points we have summed up the more important things to be thought of in the postoperative treatment in the aged. Be it always borne in mind that the aged individual is on the downward trend and does not respond to treatment like a younger adult.

Full credit is due C. R. Fancher for having abstracted all the literature to which reference is made in this chapter.

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CHAPTER LXI

SYMPTOMS AND SIGNS OF IMPENDING DEATH*

By O. F. McKittrick, St. Louis, Mo.

At the door of each and every life the grim reaper death will knock. Just when and how it will come no one can tell, and yet in spite of the millions of observations upon this, the most tragic phenomenon of life, practically nothing has been written. Neither have very great efforts been made to critically study this phase of disease, and we of the twentieth century must suffer the consequences of our negligent medical forefathers. It is a matter of common observation that the relatives, particularly the women who nurse the sick one, feel the presence of this weird specter much more quickly and keenly than does the physician himself. Possibly if he could have seen so far as they, a different and more efficient treatment might have been given with years of useful life added to the patient's career. At any rate, if the possibility of death could be foretold, the prognosis would be less often faulty.

The signs of impending death were first commented on by Hippocrates 2500 years ago. Nothing of material importance has been added since his time except a few facial signs noted by the late Austin Flint. Others have, no doubt, attempted work along this line only to have their efforts discouraged by the tradition that patients often get well despite the sentence of death pronounced by the medical judge.

The medical profession is not only called upon to answer this question thousands of times daily, but a correct solution of the problem is now required also by certain municipalities. Failure to realize that death is certain within forty-eight hours of the time a patient is moved from one institution to another is punishable by a fine. However, no one can say in the light of our present day knowledge of medicine just when fatal outcome might develop in the course of such complications as angina pectoris, myocarditis, cerebral hemorrhage, postoperative thrombosis or nephritis. Neither can the sudden unaccountable deaths, which occur daily in hospitals, be foretold. Such instances are rather an exception, and are not included in the class of cases which is discussed in the following.

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*Much of the matter in this chapter is taken from Reilly's article; Signs and Symptoms of Impending Death, Jour. Am. Med. Assn., 1916, lxvi, 160.

According to Reilly[1] "death usually occurs as a result of heart failure, respiratory failure, asthenia, vagus failure, or shock." When this last occurs, however, the centers in the medulla are the controlling factors rather than any one organ.

There are few single symptoms pathognomonic of death, but when two or more are considered, a positive statement regarding its approach often can be made. In the following sentences Reilly mentions, in the order of their importance, some of the more common danger signals which warn us of the oncoming scythe-bearer. When one of them is present others are also very apt to assert themselves.

An irregular pulse for the first time in the disease or its disappearance from the wrist with the patient recumbent is alarming, except in cardiac disease or in sudden severe hemorrhage. In the latter if there is much factitious behavior, death invariably occurs.

Pulsus alternans, appreciated by the finger, means death within a short time. This is most common in fractures of the skull.

In adults, except in heart block, a pulse under 80 means that death is at least twelve hours away. In the aged, however, the pulse is often slow until death. In these old people a pulse of 140 means death within a few hours. In children with a pulse under 120, death is rare within six hours. A pulse of 100 in coma usually means that death is eight hours off at the most. Such statements are taken to mean, of course, that the patient is safe for this length of time. A pulse mounting gradually to 160 presages death, except in pericarditis; and generally speaking, a pulse which increases in rapidity hour by hour is adequate warning of approaching death provided other signs of very serious illness are present; but the approach can not be foretold by the pulse as reliably in children and the aged as in adults.

Cases of auricular flutter are very deceptive, the pulse may be 150 or more with extreme prostration, and still recovery often occurs.

Gallop rhythm, not associated with rheumatic endocarditis, is always fatal. Of like import, is a persistent, firm pulse in coma accompanied by hemiplegia. In all infectious diseases a strong pulmonary valve sound indicates that immediate fatal termination is improbable.

In very sick patients who are free from cardiac disease, a disappearance of the pulse at the wrist when the hand is raised vertically above the head, indicates that the end may be expected within twenty-four hours.

Blood pressure change is not as good an indication of impending death as one would suppose, probably because of the fact that it is not practical to have observations made often enough. We know, however, that the blood pressure steadily drops as the end approaches.

A blood pressure of 230 falling suddenly below 100 without hemorrhage, means a fatal issue; likewise when it steadily falls in any adult to 40.

Cheyne-Stokes' respiration in the sick practically always heralds death except in uremia or cardiorenal disease. Rapid breathing following this phenomenon indicates that it is at hand.

A marked disproportion between inspiration and expiration, especially if accompanied by rapid pulse, except in shock or hemorrhage, is a terminal sign. Continued sighing under these same conditions of sternomastoid breathing in a patient free from asthma or obstruction to the larynx, heralds death.

According to Shrady, a persistent up and down motion of the Adam's apple foreshadows a rapidly fatal outcome. White frothy mucus from the nostrils announces the end.

Absence of pupillary reaction to light except in syphilis, brain diseases, optic atrophy, fainting or hemorrhage immediately precedes death; a sluggish reaction is serious. In most cases the pupil dilates widely just before the end.

A film over the eyes or tight closing of the eyelids, with a firm, rapid pulse, is a sign of impending fatality, as is a turning of the eyes outward.

In children a passive congestion of the conjunctival vessels means approaching death.

Other signs which no doubt are noticed even before those mentioned above, but which are of secondary prognostic value, are stated below.

The facies show markedly the hand of death; there is noted a pallor, the eyes are sunken and hollow, the temples are collapsed, the nostrils are pinched, and the ears which are cold and transparent have the lobes turned outward. Finally the lower jaw drops, the eyes become fixed and a haziness comes over the cornea. Aside from any intrinsic pain there appears a look of great mental distress, though the patient is unmindful of the fact. It seems as though the body is conscious of the impending danger, while the mind is oblivious to it. In such a facies every one recognizes the fact that death has already opened the door for the final departure.

A temperature of 108° F., except in heatstroke, is fatal; likewise a rising temperature on the second day after the onset of hemiplegia.

Loss of sphincter control is always a grave sign, especially when coma is present.

In peritonitis a fatal indication is a bright yellow discoloration of the tongue; likewise, black vomit coming on forty-eight hours after operation.

Persistent and uncontrollable hiccough appearing in a serious complication is usually the forerunner of death.

The appearance of large amounts of indican in the urine or transudates is a fatal indication. Subsultus tendinum and carphologia, except in typhoid, are of grave import.

Fibrillary heart-tremor in electric shock is always fatal.

Except in diseases of the central nervous system, the disappearance of the peripheral reflexes is usually a fatal sign.

Edema of the glottis in patients over 45 years of age is followed by death in a few hours.

It has been said that there is a peculiar odor to the breath in many dying patients. In rooms which have not had the best of ventilation, this is especially noticed. It is likened unto decayed apple blossoms or acetone. Some think it resembles horse-radish very closely. When once noticed it is not soon forgotten.

Fortunately few patients realize that death is at hand. The most prominent passion during life will very likely present itself during the last hours. The loss of interest at this time in things which formerly interested the patient, is a bad sign.

The presentiment of a fatal issue by the patient in cases where the condition is not particularly alarming, and when he shows very little or no interest in the consultation over his bedside, is not encouraging. Likewise when a uremic patient becomes jolly and joyous, the end is often very near at hand.

More than half of our patients die in coma. The blood pressure falls, the pulse becomes fast and ultimately irregular, the skin becomes cold and clammy, finally the well-known death rattle appears in the throat and the end has come.

Sudden Death.—Sudden death is not uncommon among individuals who were previously known to be the victims of no disease. Should it then be a matter of surprise that this distressing accident occasionally happens among those who have recently been subjected to the stress and strain of a major surgical procedure?

Few operators indeed escape the occurrence, at some time or other during their experience, of sudden unexpected and unexplained deaths among their patients. Many cases are reported in the literature, but many more have passed unnoticed, not gaining the attention of the medical profession at all. During recent years, however, more light has been shed on this subject with the result that through the efforts of Draper,[2] 1850 cases have been collected. Ferrario and Sermoine of Milan studied 1043 cases, Wescott, coroner for Middlesex district, London, reported 303 instances, and Bronardel of France called attention to 1000 cases more. Later on Blake in this country collected 225 cases. These figures are sufficient to show that a factor uncontrolled by any means on the part of the surgeon must be reckoned with in surgery, and that this factor is not of little importance.

The period of life during which sudden death is most apt to occur, according to the various mortuary records, seems to be after the age of 55. Next in frequency comes the span between 40 and 55, while about one-fourth of all sudden deaths occur before 40. It must therefore be apparent that youth and even childhood are not entirely free from this occurrence.

The causes which are usually given in death certificates for these unexpected deaths, are status lymphaticus, myocarditis, arteriosclerosis (particularly of the coronary arteries), thrombosis and embolism, of which the pulmonary variety forms 80 per cent, hemorrhage from the pancreas, acute dilatation of the heart, rupture of the heart, and valvular lesions of the heart. Recently the thymus gland in children and young adults has been noted as a causative factor as reported by Rehn,[3] Cohn,[4] Lange,[5] Zander and Keyhl,[6] Caille,[7] Falls,[8] Hart,[9] Mettenheimer,[10] Forret[11] and others.

The conditions under which these deaths occurred, according to Blake[12] who particularly studied this phase in his own collection of cases, were the following: (a) unusual exertion, one-fifth; (b) moderate exertion, one-fourth; (c) deep emotion or psychic shock less than one-fifth; (d) the remaining cases occurred during rest or sleep.

Blake therefore concludes that emotion, exercise, and exertion are frequently the exciting cause of sudden death. These same factors are attendant upon a surgical operation. He further states that the effects of apprehension and fright are very obvious, while the effect of the anesthetic upon the pulse, respiration, skin, and kidneys is precisely that of moderate exercise; furthermore, the effects of long-continued and very serious surgical interference are again precisely analogous to very severe exertion. We have, therefore, in the routine of modern surgery, reproduced with considerable accuracy the precise conditions under which a majority of sudden deaths occur. The deaths which have been attributed to the anesthetic are more than likely coincidental and would have occurred with equal certainty under any other procedure which produced these conditions.

Considerable work has been done in attempting to determine the cause of sudden deaths under anesthetics. Henderson[13] states that most of the deaths belong in one or the other of two general classes: those the result of primary respiratory failure, and caused by a cessation of the heart beat. It is well-known that carbon dioxide in the blood is the normal stimulant to the respiratory center. This is maintained at a constant level by the normal breathing. During anesthesias, however, the sensitiveness of the respiratory center is very much altered. Too light, and especially an intermittent, administration of the anesthetic, ether excitement, fear, pain, and intense emotion, which may accompany the anesthesia at times, increase this sensitiveness greatly, producing at once very rapid respiration, which in turn overventilates the lungs. This causes a decrease of the carbon dioxide of the blood, and a condition known as acapnia. The respiration, receiving no further stimulation from the inadequate amount of carbon dioxide, soon ceases. Unless artificial respiration is at once instituted, the patient dies.

The acapnia not only causes an increased sensitiveness of the respiratory center, but this condition produces deleterious effects upon the heart. This organ becomes under those new conditions hypersusceptible to the anesthetic, so that the amount which under normal conditions would not be harmful, is now sufficient to cause it to even cease its contractions. When this occurs before the respiration ceases, the case is considered as belonging to the cardiac class.

Woolsey,[14] while not decrying the acapnia theory of Henderson, states that "any agent capable of so changing the molecular state of nerve matter as to arrest its function if carried into the blood, first acts upon the nerve cells. Each change produced in one of these, be it the decomposition of a molecule or, as is more probable, the isomeric transformation of a molecule, implies a disengagement of molecular motion or nerve force, that is immediately communicated to neighboring molecule, each molecule being a center of discharged nerve force, and in the act of being incapacitated for further transmittal of motion." He further informs us that the nerve cell then being quickly acted upon and discharging as quickly as the successive molecular transformations are wrough in it, there results a general nervous chaos, a tempest of incoordinate nerve force discharge, and as can be easily seen a corresponding disorganization of the action of vital organs which depend upon fine nervous coordination for their control.

The surgical procedure with its attending trauma has as primary causative factors, first, the afferent nerve assault of fear and apprehension of the operation; second, the afferent nerve assault of the anesthetic, especially if it is imperfectly maintained throughout the operation; third, the afferent nerve assault of the operative performance and the condition for which it was performed.

All these elements, in greater or lesser degree, combine toward the end of determining the degree of central nerve disorganization which Woolsey believes is the cause of fatal terminations of otherwise good operative risks.

The more we know of the real nature of these sudden deaths, the better we shall be able to avoid them. As has been said before, no one can designate with certainty the individual who is doomed to suddenly die, or the time or manner of its occurrence, but we do know many of the pathologic conditions which predispose to it and the circumstances under which it is most apt to occur.

While attention has already been called to the complications which most frequently cause death, special notice must be taken of status lymphaticus which is comparatively frequent; and there is another condition known as status thymico-lymphaticus in which an enlarged thymus gland is found in association with the general enlargement of the lymphatic tissue. Not alone does this condition materially complicate operations upon children, but it has caused sudden death in adults, particularly in goiter operations, as reported by Rehn, Gluck, and Dwornitschenko.

In order to diminish the instance of such calamities it is absolutely necessary for more thorough histories to be taken and complete examinations of patients to be made before operations, even of a minor character, are attempted.

It is also important to try as far as possible to diminish preanesthetic fright, apprehension and intense emotion.

Every case which unfortunately terminates in this way should have an autopsy. By this means additional causes may be found and more information be obtained to stimulate careful scrutiny of a subject, which has so often been a matter of great humiliation and sorrow.

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CHAPTER LXII

POSTOPERATIVE MORTALITY

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Postoperative mortality, as it will be discussed in this chapter, will be subdivided into two groups; surgical mortality, and operative mortality. By surgical mortality we mean the death of the patient from any cause if that patient has been operated upon. By operative mortality we mean the death which is, directly or indirectly, the result of the operation; the disease for which the operation was performed not necessarily being fatal.[1] These mortality figures, however, are largely influenced by the type of cases reported. Under the list of surgical mortalities we shall attempt to give the mortality rate from anesthetics, and under operative mortalities, the mortality rate from the various operations themselves. In connection with this it will be also necessary to discuss, briefly, the relationship of anesthetic mortality and postoperative complications.

As a matter of historical interest it might be permissible to mention a few facts regarding the introduction of ether anesthesia, its mortality then and follow it roughly up to the present time.

The *Medical Gazette* on March 5, 1847, reported 28 operative cases in which ether had been used as an anesthetic—2 of these cases were fatal. In the same year the *London Chemist* for April reported another death from ether anesthesia in which the patient failed to recover from the effects of the ether. This fact, failure to recover from the effects of ether or death before the anesthesia was complete caused physicians to fear the use of ether, and led Sir James Y. Simpson to investigate the anesthetic value of chloroform. However, the dangers of chloroform were immediately seen by an initial fatality on Jan. 28, 1848, and then both ether and chloroform were regarded as being unsafe. In 1864 The Royal Medical and Chirurgical Society reported 109 deaths from chloroform, covering a period of years from 1848 to 1865. From 1865 to 1876, 101 more deaths from chloroform were reported and of these 210 deaths, 90 per cent occurred before the anesthesia was complete. From 1886 to 1889, 130 chloroform deaths were reported, 54 per cent of which occurred either before or during the operation.[2] The mortality rate is thus shown to be very high and the true cause of death was not fully appreciated until the relationship between cardiac fibrillation and chloroform syncope was realized. Levy[3] in analyzing the cases reported by the Royal Medical and Chirurgical Society in 1864, states that in 62 per cent of the cases it was shown that the patients died under light anesthesia and that 87 per cent of the deaths were not due to an overdose; also, that out of the whole series of 98 cases there is no evidence that any patient died of overdosage. From this, he concludes that these deaths are due only to cardiac fibrillation and chloroform syncope.

In 1912, 71,052 cases of anesthesia administration with 24 deaths were reported.[4] Of these, 20,613 were chloroform administrations, death occurring 1 in every 2,060 cases; 11,859 were ether cases with a fatality of 1 in 5,930. This series also includes 10,230 cases in which chloroform was the primary anesthetic followed by ether. The mortality here was 1 in 3,410 cases. In the same year Bevan at the American Medical Association meeting reported the following deductions:

1. That the use of chloroform as an anesthetic for major operations is no longer justifiable.
2. That for minor operations the use of chloroform should cease.
3. That chloroform is sometimes found convenient in initiating anesthesia in alcoholics or difficult subjects.

The first two points have been accepted without hesitation, but in regard to No. 3 recent investigations show that chloroform should never be used as a preliminary drug.

In obtaining figures for anesthetic mortalities at the present time one meets with many difficulties. To determine the total number of administrations would be impossible; also, we can not find any standard by which we can determine what constitutes an anesthetic death. Various opinions have been given and a few are mentioned. Roberts[5] concludes that death in general anesthesia in the majority of cases is due to improper administration of the drug with subsequent poisoning. Williams[6] believes that anesthetic deaths reported as such are not always the result of the anesthetic. Other men attribute status lymphaticus as a cause. Henderson[7] says that "in a large majority of deaths of cardiac type, the expressions hypersensibility to anesthesia, heart disease, or status lymphaticus are mere excuses, and that the patient is killed by the method of administration of the drug." He further says that it is not the anesthetic agent at the time which kills the patient, but instead, the treatment, which the patient receives half an hour or so earlier is really the cause of death.

Many deaths which occur during or following an operation can not be said definitely to be caused by the anesthetic, neither can we definitely estimate the influence the anesthesia had in producing these deaths. In such cases of postoperative deaths the result of septicemia, peritonitis, hemorrhage and emboli of the lungs, heart, or brain, we can not consider the anesthetic as a cause of death. In cases of death the result of aspiration pneumonia, suffocation from pressure on the larynx during operation, we again can not lay the cause of death to the anesthetic, although death might not have occurred had no anesthesia been given. So in giving the figures on anesthetic deaths, we hope to adhere as closely as possible to those occurring from overdosage or improper administration, bearing in mind that with improper administration such complications as cardiac and respiratory failure may result. We must also consider those deaths due to delayed chloroform poisoning, of which 82 are reported in the literature.[8] Braun states that late chloroform poisoning presents the picture of acute yellow atrophy of the liver. Graham[9] attributes it to the HCl set free in the tissues when the chloroform is oxidized.

The mortality rates from various anesthesias will be considered as follows: Deaths under:

I. Ether.
II. Chloroform.
III. Ethyl Chloride.
IV. Nitrous Oxide-oxygen.
V. Spinal Anesthesia.
VI. Scopolamine.
VII. Local Anesthesia.
VIII. Other methods.

I AND II. UNDER ETHER AND CHLOROFORM

UNDER ETHER				UNDER CHLOROFORM		
REPORTER	CASES	DEATHS	MORTALITY RATE	CASES	DEATHS	RATE
Richardson[10]	8,431	1		35.162	11	1 in 3,196
Julliard[11]	314,738	21	1 in 14.987	524,507	161	1 in 3,258
Ormsbee[12]	92,815	4	1 in 23,204	152,260	53	1 in 2,837
St. Barth. Hospital[13]	37,277	4	1 in 8,318	42,987	33	1 in 1,300
German Sur. Society[14]	56,333	11	1 in 5,121	240,806	116	1 in 2,075
Neuber[15]	11,859	2	1 in 5,930	20,613	10	1 in 2,061
Gwathmey[16]	294,653	65	1 in 4,533	16,390	8	1 in 2,048
McGrath[17]	49,057	0		1,300	0	
Average mortality rate			1 in 8,010			1 in 2,665

The average mortality under ether was 0.012 per cent while that under chloroform was 0.038 per cent or three times that under ether. W. H. Keen has collected 262,002 cases of ether administration from various sources, with 34 fatalities; the mortality being 1 in 7,705.[18]

III. UNDER ETHYL CHLORIDE

REPORTER	CASES	DEATHS	REFERENCE
Soullier	8,417	0	Bull. Med. Paris, 1895.
Lotheissen	2,550	1	Ware: Med. Rec., April, 1901.
Newman	1,867	1	Cumston: Boston Med. and Surg. Jour., January, 1905.
McCardie	12,000	4	British Med. Jour., March, 1906.
Luke	2,000	0	Lancet, London, May, 1906.
Lee	5,575	1	Internal Clinics, iv, 19th Series.
Herrenknecht	3,000	0	München. med. Wchnschr., December, 1907.
Webster	1,880	0	Surg., Gynec. and Obst., April, 1909.
Steida	1,000	0	Med. Klin., March, 1912.
Zanda			
Miller	6,648	1	Jour. Am. Med. Assn., November, 1912.
Hornabrook	18,813	0	Austin Med. Gaz., April, 1914.
Greene	5,000	0	Am. Jour. Surg., July, 1915.
Ware	15,000	0	Am. Jour. Surg., July, 1915.

In addition Peterka[19] reports 9 deaths out of 100,971 cases of ethyl chloride anesthesia, or a mortality rate of 1 in 11,219. Out of 53,403 cases collected by Miller[20] he reports 4 deaths or a mortality of 1 in 13,365.

IV. UNDER NITROUS OXIDE-OXYGEN

REPORTER	CASES	DEATHS	REFERENCE
Gwathmey	8,585	0	Jour. Am. Med. Assn., Nov., 1912.
Jones	13,000	1	Ohio State Med. Jour., Aug., 1915.
Lower and Crile	34,946	0	Anoci-Association, 1915.
Teter	23,952	1	Jour. Am. Med. Assn., November, 1912.

Of 1,500,000 cases collected and reported in the *Birmingham Medical News* for April, 1893, 2 deaths were recorded. Buxton in 1900[21] reports 1,001,000 cases with one death. The mortality rate by others, Gwathmey[22] has been placed as 1 in 20,000 which might be considered high as compared with others.

V. UNDER SPINAL ANESTHESIA

REPORTER	CASES	DEATHS	REFERENCE
Risch	315	2	Zeit. f. Gyn., July, 1907.
Chaput	7,000	0	Anesthesia; Gwathmey, 1914.
Kronig and Gauss	1,000	3	München. med. Wchnschr., Oct., 1907.
Colombani	1,100	0	Wien. klin. Wchnschr., Sept., 1909.
Gray	300	1	Anesthesia, Gwathmey, 1914.
Hohmeier	2,400	12	Arch. f. klin. Chir., xciii, No. 1.
Jonnoesco	2,963	2	Bull. de L'Acad. de Med., 1910.

V. UNDER SPINAL ANESTHESIA—CONTINUED.

REPORTER	CASES	DEATHS	REFERENCE
Violet and Fisher	270	1	Lyons Chir., Nov., 1910.
Kohler	7,780	12	Brit. Med. Jour., Jan., 1910.
Hahm	708	8	Brit. Med. Jour., Jan., 1910.
Helm	1,419	0	Beit. z. klin. Chir., lxxi-v.
Barker	2,354	3	Anesthesia, Gwathmey, 1914.
Gwathmey	521	0	Jour. Am. Med. Assn., Nov., 1912.
Bainbridge	1,065	1	Jour. Am. Med. Assn., Nov., 1912.
Allen	320	0	Jour Am. Med. Assn., Nov., 1912.
Babcock	5,000	11	Am. Jour. Obst., Nov., 1914.
Gellhorn	63	0	Jour. Am. Med. Assn., June, 1914.
Merenes	169	0	Ann. Surg., Dec., 1913.

This series of cases gives a mortality rate of 1 in 515. Other investigators report cases as follows: Strauss, 22,717 cases with 46 deaths, Chiene, 12,000 cases with 36 deaths, the average mortality being 1 in 623.[23]

VI. UNDER SCOPOLAMINE

REPORTER	CASES	DEATHS	REFERENCE
Maass	1,499	11	Therap. Monatschr., Aug., 1905.
Roith	4,000	18	München. med. Wchnschr., 1905.
Muhsam	28,809	5	Med. Klin., June, 1912.
Viron and Morel	2,000	25	Progrès. med., xxii, 1906.
Beach	1,000	0	Am. Jour. Obst., May, 1915.
Rongy	2,000	0	Am. Jour. Obst., May, 1915.

The average mortality in this series was 1 in 666 cases. H. C. Wood, Jr., has collected 1,988 cases of scopolamine anesthesia from the literature and reports a mortality rate of 1 in 221.

VII. Under Local Anesthesia. No accurate list of cases could be obtained, but a certain number of fatalities have been reported by such men as Proskauer,[24] Lichtenstein,[25] Miller,[26] Gwathmey,[27] and 6 cases by Flemming.[28]

VIII. Under Other Methods. Death from anesthesia is also met with when other methods of administration are employed. Pikin[29] reports 12 cases of intravenous anesthesia with 1 death. Homans and Hassler report 1 death out of 350 cases.[30] Woolsey reports 5 deaths from intratracheal anesthesia,[31] while Robinson reports 7 deaths out of 1402 cases.[32] The following men report deaths from rectal anesthesia; Weir 1,[33] Baum 2,[34] Carson 2,[35] Cunningham 1.[36]

In regard to postoperative complications referable to anesthetics, Homans[37] divides these into three groups.

1. Complications which depend directly upon the anesthetic and result from inhaling or aspirating infected material into the lungs.
2. A condition of hypostatic pneumonia due to enfeebled circulation and failure to keep the lungs clear.
3. Emboli.

It has been shown by Graham[38] that the "reduction of the phagocytic power of the blood after an ordinary ether anesthesia continued in different experiments over periods of 2 days to 7 weeks in duration." We are thus shown how ether will lower the natural resistance of the body and make the patient more liable to infection. With regard to the effects of ether on the lung tissue itself Chapman[39] states that ether has an irritating effect on the lung tissue with subsequent swelling of the alveoli and congestion, and in some cases even hemorrhage which is proportional to the amount of ether given. From these two observations one can easily see how patients may readily contract such complications as aspiration or hypostatic pneumonia. Miller[40] states that ether lowers the coagulation time of the blood which he thinks may play an important part in the production of postoperative emboli or thrombi. In regard to the fatalities due to lung complications Homans[41] reports a collected series of 15,043 laparotomies with a death rate of 4.4 per cent; from Boston hospitals he reports from a collection of 3,089 laparotomies with a mortality of 0.4 per cent due to these same complications. Out of a collection of 6,825 operations Beckman[42] reports lung complications in 87 with no deaths.

Considering next the heading, operative mortality, it might be well to consider, briefly, the evolution of antiseptic surgery and its bearing on the mortality of operations. Lucas Championniere has been quoted as saying that there were only two periods in surgery—that before Lister and that after Lister. With the advent of the nineteenth century, surgery was revolutionized. The cause of putrefaction of animal and vegetable material, was being investigated and many theories were given only to be cast aside, until Pasteur made his famous studies on the fermentation of alcoholic beverages. He showed that not only the fermentation of beer and wine was due to living organisms, but that all putrefactions were due to the same cause. In 1845 a step further in the support of the germ theory of disease was made by Semmelweiss who discovered that puerperal fever in the General Hospital at Vienna was due to infection borne from the dissecting room on the hands of the students, and, by insisting on hand cleansing with chlorinated lime water he reduced a mortality rate of 12.24 per cent to 1.27 per cent. In 1862 Pasteur's experiments lead him to the conclusion that suppuration was but a fermentation of flesh and that this might be prevented by destroying the germs that caused it or by preventing their entrance. To this end he urged the use of boric acid for surgical purposes. In 1878 he advocated the use of bandages and sponges which had been previously heated to a temperature between 130° C. and 150° C. and water which had been previously heated to 110° C. or 120° C. Up to this time no adequate surgical dressing had been introduced, though in 1854 the use of carbolic acid was made by Lemaire of Paris, and in 1855 it was first employed at St. Mary's Hospital in London.

The great values of these discoveries as applied to surgery were left to be demonstrated by Lister. When Lister entered the University of Glasgow as Professor of Surgery in 1860, tetanus, erysipelas, septicemia, pyemia and hospital gangrene were scarcely absent from the wards. There was no knowledge of their cause or any means to prevent them. Lister then insisted upon scrupulous cleanliness in the wards, frequent washing of the hands of all attendants either at operations or at wound dressings, and frequent changing of the dressings of suppurating wounds. To overcome the decomposition of the injured part Lister advised the use of carbolic acid in the dressing so as "to destroy the life of the floating particles" (microbes). He also observed that dead tissue when protected from external influences was absorbed. This led to the idea of catgut ligatures. It is not necessary to chronicle every step in the advance of asepsis, but suffice it to say that by this time operations were performed with success which formerly could have ended only in failure. In 1877 Lister still employed carbolized gauze, carbolic spray, and oiled silk but was ever on the lookout for improvements, and when bichloride of mercury was proved to be more powerful than carbolic acid, he experimented with it and suggested the gauze dressing impregnated with double cyanide of mercury and zinc which is still used by many. Ultimately when the carbolic spray was found inadequate to destroy bacteria in the dust, Lister abandoned it, but nevertheless paved the way for our modern methods of surgery. Today figures from the London Hospital show that 98 per cent of operative wounds heal by first intention, whereas, 50 years ago 80 per cent were attacked by hospital gangrene.[43]

The following mortality lists of various operations are made from a variety of sources, but represent those from reliable hospitals or operators. Not every operation practiced is tabulated, but only those which are considered worthy of mortality figures, either on account of their severity or from their common occurrence.

A. Alimentary System.[44]

I. Lymph-adenoid:

Tonsillectomies and adenoidectomies; **574 cases, 2 deaths.**

Ochsner reports 593 cases with no **deaths.**[45]

II. Esophagus:

Gastrostomies for carcinoma; 13 cases, 8 deaths. These deaths were due to the malignancy of the disease.

III. Stomach, Pyloris and Duodenum.

Gastroenterostomies for neoplasms: 70 cases, 5 deaths. Ulcers, either excisions or resections: 67 cases, 1 death.

Mayo,[46] out of 1000 cases of ulcer, irrespective of operations, types or cases, reports a mortality of 2.4%.

In malignancy of the stomach, gastrostomy being done, Mayo[47] reports an immediate mortality of 25 to 55%.

In the same operation and cause, McCosh reports a mortality of 30%; Robson, 38.3%; Czerny, 38.5%; Mukulicz, 32%.

IV. Liver and Biliary Tract:

Cholecystostomies — choledochotomies — cholecystectomies, etc.: 210 cases with 14 deaths.

The Mayo brothers report the following series of operations for a period of ten years:[48]

Removal of benign tumors, 311 cases, 8 deaths.

Removal of malignant tumors, 17 cases, 3 deaths.

A later report[48] of 1500 cases operated upon shows 66 deaths or a mortality of 4.43%. Of the first 1000 cases 845 were cholecystostomies with a mortality of 2.1%; of the last 500 the mortality for the same operation was 1.47%. The mortality of cholecystectomies for the first 1000 cases was 3.13% and for the last 500 cases 1.62%.

Their figures for operations on the common duct are as follows:

Stones—partial obstruction, 105 cases, 3 deaths, mortality 2.9%.
complete obstruction, 29 cases, 10 deaths, mortality 34%.
with infection, 61 cases, 10 deaths, mortality 16%.
malignancy, 12 cases, 4 deaths, mortality 33%.

Ochsner[45] reports 124 cholecystectomies with 7 deaths; and 39 cholecystostomies with 2 deaths.

V. Intestines.

Appendectomies, 625 cases, 20 deaths.

Ochsner reports 655 cases with 3 deaths.[45]

Hernias—Epigastric, 12 cases, no deaths.
Femoral, 43 cases, no deaths.
Ventral, 35 cases, no deaths.
Umbilical, 23 cases, 5 deaths.
Inguinal, 506 cases, 4 deaths.

Ochsner[45] reports—Femoral, 7 cases, 2 deaths; Inguinal, 68 cases, no deaths; Ventral, 15 cases, no deaths; Umbilical, 4 cases, no deaths.

VI. Rectum and Anus:

Hemorrhoids, ligation and excision by various methods, 186 cases with no deaths.

Fistula and Fissure, 43 cases and no deaths.

Resection of rectum, 20 cases, 2 deaths.

Ochsner[45]—Hemorrhoids, 87 cases, no deaths.
Obstruction, 17 cases, 9 deaths, operation late.
Resections and colostomies for carcinoma, 12 cases, 2 deaths.

B. Vascular System:[44]
  I. Varicose veins and ulcers, excision, 164 cases and 1 death.

C. Ductless Glands.[44]
  I. Hypophysis—transsphenoidal, sellar decompressions, etc., 75 cases and 2 deaths.
  II. Thyroid.
    Partial Thyroidectomy:
      Adenoma, cysts, etc., 25 cases, no deaths.
      Colloid, 8 cases, no deaths.
      Hyperthyroidism, 29 cases, 1 death.
      Dysthyroidism, 5 cases, no deaths.
    Ochsner reports 128 cases with 4 deaths.
    Kocher reports 11 deaths from partial thyroidectomy for benign growths from 870 cases or a mortality of a little more than 1%. His later mortality figure is 3 out of every 1000 cases.[49]

D. Nervous System:[44]
  I. Skull: decompressions, craniotomies, etc., for tumors, trauma, hemorrhage, abscess, etc., 399 cases, 73 deaths.

E. Reproductive System:[44]
  I. Breast:
    Removal for benignancy, 29 cases, no deaths.
    Ochsner, same, 32 cases, no deaths.[45]
    Removal for malignancy, 61 cases, 1 death.
    Ochsner, same, 34 cases, no deaths.[45]
  II. Uterus:
    Hysterectomies, abdominal and combined routes, 83 cases, 2 deaths.
    Mayo reports 504 myomectomies from January 1, 1891, to September 1, 1916, with 4 deaths or a mortality of 0.8%.[50]
    Ochsner's figures are as follows:
    Hysterectomies and Panhysterectomies, 92 cases, 4 deaths.[45]
  III. Uterine Appendages:
    Salpingectomies, salpingo-oophorectomies, 119 cases, 4 deaths.
    Ochsner[45]—on salpinx, 41 cases, 1 death.
      on ovary, 44 cases, 2 deaths.
  IV. Prostate:
    Prostatectomies or Prostatomies, 61 cases, 5 deaths.
    Ochsner,[45] same operation, 25 cases, 2 deaths.

F. Respiratory System.[44]
  I. Pharynx:
    Tracheotomy, 2 cases, no deaths.
  II. Lungs and Pleuræ:
    Thoracostomies, 65 cases 6 deaths.
    Ochsner,[45] same operations, 30 cases, 4 deaths.

G. Skeletal:
  I. Osteomyelitis, acute and chronic, 146 cases, 2 deaths; Tuberculous, 8 cases, no deaths; Actinomycotic, 2 cases, no deaths.

H. Urinary System:[44]
  - I. Kidney:
    - Nephrectomies, 21 cases, no deaths.
    - Nephrotomies, 81 cases, 5 deaths.
  - II. Ureter:
    - Ureterotomies, 17 cases, no deaths.
  - III. Bladder:
    - Supra-pubic cystotomies, 29 cases, 1 death.
    - Ochsner,[45], 25 cases, no deaths.

We will not attempt to summarize or lay down any conclusions regarding postoperative mortality as discussed in this chapter, since in doing so we would only make a repetition of the figures already given. The tabulated figures themselves serve the best deductions and conclusions that we can offer.

Full credit is due B. L. Adelsberger for having abstracted all the literature to which reference is made in this chapter.

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